Do firms care about investment opportunities? Evidence from China

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Abstract

What drives a firm's investment decisions in China? While most literature focuses on the role of financial factors (such as cash flow), we explore this most important question in corporate finance from the perspective of economic fundamentals. Using a large number of proxies for investment opportunities and a variety of econometric approaches, our empirical results show that it is private firms that make the most of all types of investment opportunities in China. State-owned enterprises respond more to the investment opportunities from the supply side, but much less so to demand-side shocks and future profitability. Financial sector development is found to be conducive to the improvement of the investment efficiency of private firms by making them take better advantage of all types of investment opportunities in their decision-making. Our research calls for further institutional and financial sector reforms in China.

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1 Introduction

Corporate finance literature has long recognized the role of economic fundamentals in determining firms' investment decisions. In the perfect world of Modigliani and Miller (1958), firms' financial structure and financial policy are irrelevant for their real investment decisions, whereas positive shocks to the fundamental factors (such as factors capturing marginal productivity of capital) should lead to an increase in investment, as firms will take advantage of better investment opportunities. However, in the absence of a perfect capital market, a variety of frictions and distortional forces (such as information asymmetry and agency problems) may prevent firms from making investment optimally, thus making their investment expenditure less responsive to investment opportunities.

Despite the paramount role of fundamental factors in driving corporate investment, research on Chinese firms' investment behaviour focuses mainly on the financial factors, i.e. investment-cash flow sensitivities. There are at least two problems. First, there has been a long debate on whether the sensitivity of firms' investment to their cash flows should be interpreted as an indicator of financial constraints (Fazzari et al., 1988; Kaplan and Zingales, 1997; Hubbard, 1998; Gilchrist and Himmelberg, 1998; Bond et al., 2004). The general criticism is that the relationship between cash flow and investment may stem from the correlation between cash flow and omitted or mismeasured investment opportunities. Second, focusing on financial constraints alone cannot explain why private firms, which are generally believed to be more financially constrained, invest more and grow faster than unconstrained state-owned enterprises (SOEs), and have become the main driving force of China's remarkable economic growth in the past few decades.

Recent literature attempts to address the second problem in a more general way, that is, how did China manage to invest and grow despite its malfunctioning financial system? For instance, Allen et al. (2005, 2012) find that private firms are externally financially constrained and have to rely on informal finance such as funds from private credit agencies and alternative channels to finance their investment. Guariglia et al. (2011) attribute the rapid growth of private firms to their abundant internal funds and high productivity. Ding et al. (2013) emphasize the role of working capital management in mitigating the effects of financial constraints in the non-state sector. Cull et al. (2015) demonstrate the importance of government connections when it comes to private firms alleviating their financial constraints. All these papers provide interesting and convincing analyses of various ways in which financial constraints faced by private firms could be relieved, but they fail to answer the more fundamental questions, such as, why do firms (both SOEs and non-state firms) want to invest in China and do they care about investment opportunities? We aim to fill this important gap in the literature, and this will be our first contribution to the field.

The second contribution of our work lies in the way in which we construct and examine the economic fundamentals. Using a large number of proxies, we break down investment opportunities into the supply- and demand-side factors, which suggests a new direction for measuring fundamentals. This is inspired by the work of Foster et al. (2008), which assumes that a firm's value is determined by both a demand shifter and productivity. We also adopt the forward-looking approach proposed by Gilchrist and Himmelberg (1995) to measure investment opportunities. The long- and short-run responses of investment to various components of investment opportunities are examined in the static regression analysis and the dynamic impulse-response analysis, respectively. Some exogenous policy shocks from both the demand- and supply-sides are also employed to further shed light on the causal effects. To the best of our knowledge, none of the existing literature attempts to adopt such a rigorous approach to measuring and examining investment opportunities in China.

Using a panel of more than 394,000 firms over the period 1998-2007, we find that investment by private firms exhibits a higher sensitivity to all types of proxies of investment opportunities than their state counterparts, implying that private firms place greater value on investment opportunities in China. This finding provides a new explanation for the question of why private firms, despite various financial constraints, are able to invest more and grow faster. The results of SOEs are interesting too, in that they seem to respond more to investment opportunities from the supply side, but much less so to demand shocks. Financial development is found to affect private firms' response to investment opportunities, but not that of SOEs. The heterogeneous response of firms with different ownerships shows that China is a unique and ideal laboratory for studying the effect of economic fundamentals on investment, given the widespread and heterogeneous frictions faced by different firms.

The rest of this paper is organized as follows. Section 2 briefly reviews the relevant corporate finance literature on investment opportunities and China's institutional background on ownership reforms and financial sector development. Section 3 discusses our empirical methodology with a focus on various measures of investment opportunities and the baseline model specification. Section 4 presents the data description, summary statistics, and empirical results of the baseline model. Section 5 reports the results of various robustness checks, including the firm-specific factors, exogenous policy shocks, short-run investment dynamics and financial sector development. Section 6 concludes the paper.

2 Related literature and background

2.1 Investment opportunities in the corporate finance literature

In an efficient market without frictions, it is the fundamental factor that determines the investment policy of profit-maximizing firms. According to Hayashi (1982), the proper measure of investment opportunities is the present value of expected future profits from additional capital investment, that is, the marginal q. He shows that under certain conditions, this shadow value of an additional unit of capital can be a sufficient statistic for investment. Theoretical models of imperfections in capital markets imply that external financing could be more costly than internal financing for many firms. Thus for given levels of investment opportunities, information costs and market interest rates, firms with higher net worth should invest more (Hubbard, 1998). In other words, financial variables can have an impact on real variables.

Measuring firms' investment opportunities is viewed as one of the challenges when empirically examining the effect of capital market imperfections on firms' investment decisions. This is because the marginal q is not observable, so that other proxies have to be identified to measure investment opportunities. Following Hayashi (1982), the average q (or Tobin's q), defined as the ratio of a firm's market value to the replacement cost of its assets, is usually used as a proxy for marginal q in investment regressions. Since stock market valuations may differ considerably from firms' fundamental or intrinsic values, it is not surprising that the q theory of investment has received little support from empirical tests based on regressions of investment on average q (Whited, 1994; Erickson and Whited, 2000).

One way to circumvent some of the problems associated with the conventional Q model is to estimate a firm's intertemporal first-order condition for investment, that is, the Euler equation (Whited, 1992; Bond and Meghir, 1994). Despite various benefits provided by this approach, Euler equation estimates rely on the period-by-period restriction derived from a firm's first-order conditions, and are sensitive to specification, generally failing to hold for firms that have been identified as financially constrained (Whited, 1998; Hubbard, 1998).

Many other efforts have been made to improve the measurement of investment opportunities, but they all reach different results. Some researchers find that financial factors matter even when fundamental factors are better captured. For instance, Gilchrist and Himmelberg (1995) construct a measure of fundamental q using a PVAR forecasting framework, where they break down the effect of cash flow on investment into two components, namely, one that forecasts future profitability under perfect markets as a proxy for marginal q, and a residual component that captures financial frictions. They find that investment still responds to cash flow even after controlling for its role as a forecasting variable for future investment opportunities. Using a similar approach, Gilchrist and Himmelberg (1998) develop improved measures of marginal profitability of capital which sharpen the distinction between fundamental and financial factors. Their structural estimation shows that investment is responsive to both fundamental and financial factors, as predicted by the existence of financial frictions. Using UK firm-level data, Carpenter and Guariglia (2008) augment the average q with a new proxy for expectations reflecting the evaluation of opportunities by firms' insiders, and find that the explanatory power of cash flow falls for large firms, but not as much for small firms. They argue that the significance of cash flow stems from its role in capturing the effects of credit frictions.

Other researchers challenge this view, and claim that fundamentals are more important for investment spending. For example, Erickson and Whited (2000) adopt a GMM estimator based on higher order moment conditions which allows for persistent measurement error in stock market valuations as a measure of the firm's fundamental value. They find that investment is insensitive to cash flow when this form of measurement error is controlled for. Using a model of investment behaviour where heterogeneous firms face costly external finance, Gomes (2001) finds that the positive investment-cash flow sensitivities commonly found in the literature are due to a combination of measurement error in q and identification problems, and do not necessarily signal the presence of financial constraints. Cummins et al. (2006) reach similar results when they employ the firm-specific earnings forecasts from securities analysts to construct a measure of average q which does not rely on stock market valuations.

2.2 Measuring investment opportunities in China

Corporate finance literature on China focuses mainly on the effect of financial factors (such as cash flow and leverage) on firms' investment (or growth) behaviour, after controlling for various proxies for investment opportunities. Firth et al. (2008) examine the nexus between leverage and investment in China's listed firms. In addition to Tobin's q, they use sales growth to capture firms' growth prospects, as the former can be a poor indicator of firms' fundamental value, given the underdevelopment of China's stock market. They discover a negative relationship between leverage and investment, and find that this relationship is weaker for firms with low growth opportunities and poor operating performance, and with a higher level of state shareholding.

Ding et al. (2013) investigate the linkages between investment in fixed and working capital and financing constraints based on a large panel of unlisted firms. They use the time dummy interacted with industry dummy to capture investment opportunities, as these dummies are believed to account for all time-varying demand shocks at the industry level. They find that good working capital management may help firms to alleviate the effects of financing constraints on fixed investment. Using the same dataset, Guariglia et al. (2011) examine the effect of financial constraints on firms' asset growth. In addition to the time dummy interacted with industry dummy, they use industry-level value-added growth to account for investment opportunities, as value-added is viewed as an overall measure of efficiency within a certain disaggregated industry. They find that abundant internal funds (cash flow) help private firms grow, despite their being discriminated against by financial institutions. Based on the World Bank survey data of Chinese manufacturing firms, Cull et al. (2015) explore the role of government connections in shaping the nexus between financial constraints and investment. Both firm-level sales growth and industry-level Tobin's q are used to proxy growth opportunities. They find that government connections alleviate the financial constraints faced by non-state firms.

Some recent studies use investment-investment opportunity sensitivities to shed light on firms' investment efficiency in China. Using Tobin's q to represent investment opportunities, Chen et al. (2011) find that investment efficiency is much lower in state-owned listed firms, as indicated by the weaker sensitivity of investment expenditure to investment opportunities. They also find that political connections reduce investment efficiency in listed SOEs, but not in the non-state sector. Based on a large panel of unlisted firms, Ding et al. (2016b) confirm the view that SOEs are less efficient in their investment decisions, where sales growth is used as a measure of investment opportunities. They also provide direct evidence of overinvestment in all types of firms, but find that SOEs and private firms tend to overinvest for different reasons. Jiang et al. (2018) find that the presence of multiple large shareholders enhances Chinese listed firms' investment efficiency, curbs potential overinvestment and increases future investment performance, where investment opportunities are captured using the conventional Tobin's q.

In brief, despite the vibrant literature on corporate finance aiming at improving the measurement of economic fundamentals, very little work has been done on China, where the research focus is mainly on financial factors, and investment opportunities are merely controlled for by the use of conventional and imperfect methods. In this paper we aim to (at least partly) fill this important gap, and provide new approaches and evidence on investment opportunities in China.

2.3 China's institutional background

China underwent significant institutional changes during the period 1998-2007. First, there was a rapid rise of the private sector with a corresponding shrinkage of SOEs, whose directive was to fulfill production quotas, transfer profits to the government, and provide life-long employment. The 15th Congress of the Chinese Communist Party, held in 1997, sanctioned ownership reforms of SOEs and legalized the development of private enterprises (Zhu, 2012). During 1998-2007, more than 80% of SOEs were shut down or privatized; by 2007, almost half of SOEs were registered as private firms, and private firms alone accounted for 51% of total urban employment in the manufacturing sector (Hsieh and Song, 2015). Unlike SOEs, which are subject to government intervention, private firms' overwhelming objective is profit maximization, and more than 60% of R&D spending and 65% of patent applications come from private firms (Fan and Hope, 2013). Lardy (2014) uses the term 'markets over Mao' to highlight the importance of this ownership reform for China's growth success, which implies that the shutdown of loss-making SOEs has released substantial resources that are more profitably employed by private firms, and the privatization of SOEs is productivity-enhancing by aligning more closely the control and cash flow rights within firms.

Second, there were dramatic and positive changes within the SOE sector during this period. One influential reform was 'grasp the large, let go of the small', where small SOEs were closed or privatized, whereas large SOEs were merged into large industrial conglomerates and control over them was consolidated by central and local governments. This reform has proved to be successful. According to Hsieh and Song (2015), the corporatization of surviving SOEs and the entry of new SOEs collectively account for 21% of growth during this period. Both labour productivity and total factor productivity (TFP) of privatized and surviving SOEs have increased dramatically as a result of improved governance among large SOEs and greater competition from both the private sector and among SOEs. This has led to a contrasting view of China's development model, 'the state advances, the private sector retreats', which emphasizes the importance of direct and indirect government control over the economy for China's growth success, that is to say, although many SOEs were closed or privatized, the remaining ones are now among the largest and most successful firms in various strategic industries in China.

Third, there are two contrasting views of China's financial sector reforms. A traditional view focuses mainly on its inefficient and 'repressed' nature, meaning that the government has intervened, and continues to intervene, in bank lending to favour the state sector in order to keep unprofitable SOEs afloat during the reform process (Riedel et al., 2007). Despite the gradual reform of the banking sector, it is only in SOEs that bank loans constitute a major share of investment financing. These loans are made at rates well below what would have been the competitive rate of interest for borrowers, and are made without close monitoring. By contrast, private firms, the driving force of the economy, are generally discriminated against by the formal financial system and have to pay high interest rates on rationed loans or rely predominantly on internal funds for investment (Allen et al., 2005; Knight and Ding, 2012). However, Lardy (2014) challenges this view: although SOEs still receive a share in bank loans that is disproportionate to their diminishing share in the economy, the access of private firms to bank credit has improved dramatically in recent years. He believes that the familiar image of SOEs massively increasing their borrowing from state-owned banks at the expense of private firms is misleading, as the latter were also big borrowers, especially during and immediately after the global financial crisis. Jiang et al. (2017) echo this view and argue that the belief that Chinese banks discriminate in their lending may be overstated.

Given the complex nature of China's ownership and financial reforms and the absence of consensus regarding their outcomes, we are interested in examining which types of popular views are supported by our data (which corresponds well to this dynamic period with dramatic institutional changes).

3 Empirical methodology

3.1 Our measures of investment opportunities

Considering the importance of measuring investment opportunities for our research questions and the corresponding challenges as described in Sections 2.1 and 2.2, we construct three groups of proxies for investment opportunities from the supply side, demand side and the forward-looking perspective. Our idea of breaking down economic fundamentals into supply- and demand-side factors originates from Foster et al. (2008), who propose a net revenue function consisting of both the demand shifter and productivity.[1] A more fundamental forward-looking approach is also adopted to provide an alternative measure of investment opportunities.

3.1.1 Supply-side investment opportunities

We use TFP growth as a proxy for supply-side investment opportunities (q^S). According to Syverson (2011), TFP is a fundamental factor from the supply side and profits increase in

[1] See Appendix A for more detailed discussion on the theoretical framework.

productivity, which is measured as a component independent of observable labour, capital, and intermediate inputs in the production function. Foster et al. (2008) echo this view and find that the increase of producers' productivity can lower the marginal costs of the input and consequently increase profits. This literature inspires us to adopt TFP growth as a candidate for the supply-side shock to investment opportunities.

We estimate the following Cobb-Douglas production function for different industry subgroups (at the 2-digit level) to allow for differences in technologies:

$$y_{i,t} = a_0 + a_k k_{i,t} + a_l l_{i,t} + w_{i,t} + e_{i,t}, \tag{1}$$

where $y_{i,t}$ is the natural logarithm of value-added of firm i at time t, defined as sales minus intermediate inputs plus value added tax; $k_{i,t}$ is the natural logarithm of a firm's capital input, which is computed using the perpetual inventory method following Brandt et al. (2012); $l_{i,t}$ is the natural logarithm of a firm's labour input, as measured by total employment; $w_{i,t}$ represents the productivity difference known to the firm, but unobservable to us; and $e_{i,t}$ is either measurement error or a shock to productivity which is not observable by firms before making their input decisions at time t.

The productivity literature has recognized the challenges of TFP estimation at the micro level (Van Biesebroeck, 2007; Van Beveren, 2012). For instance, there are the problems of endogeneity of input choices (or simultaneity bias), the omitted variable bias (if data on physical inputs and output and their corresponding firm-level prices are unavailable), the sample selection bias (as a result of there being no allowance for firm entry and exit), and the multiple-product-firm problem (which arises when production technology differs across products produced by a single firm).

We adopt four different methods to estimate equation (1) in order to produce consistent and robust TFP estimates. First, we opt for the Levinsohn and Petrin (2003) approach (hereafter LP), which uses intermediate inputs to proxy unobserved productivity ($w_{i,j,t}$) in order to address the problem of endogeneity of input choices (or simultaneity bias). This approach can also tackle the criticism of lumpy investment faced by Olley and Pakes (1996) (hereafter OP). Second, we use the method of Wooldridge (2009) (hereafter WLP), which is a unified approach allowing for a possibility that the first-stage LP or OP estimation contains identifying information for parameters on the variable inputs, such as labour. Third, we adopt the recent approach of Ackerberg et al. (2015) (hereafter ACF) which resolves the functional dependence problems that LP or OP face by precluding the identification of the labour coefficient in the first-stage estimation. They argue that the use of conditional input demand functions allows for a more general data-generating process and produces more consistent estimates compared to LP or OP, and their two-stage procedure is less error-prone and more time-efficient than Wooldridge's joint approach. Lastly, the GMM estimator (hereafter GMM) is used to estimate TFP, where fixed effects are allowed to take into account firms' (unmeasured) productivity advantages that persist over time. Van Biesebroeck (2007) regards GMM as the most robust technique when measurement errors and technological heterogeneity are present among five widely used productivity measures. The GMM estimator has been extensively employed in some recent productivity and trade literature (De Loecker and Warzynski, 2012; Ding et al., 2016a; Brandt et al., 2017).

Our approach is based on the recent development in the application of TFP estimation methods in order to alleviate potential measurement errors. For instance, first, we use different industry-specific price deflators for inputs, outputs and investment, which are drawn from the seminal work of Brandt et al. (2012). Given the absence of firm-specific price deflators, our TFP measure is a revenue-based productivity measure (TFPR) as introduced by Foster et al. (2008), which may capture both technical efficiency and price-cost markups. This also justifies our use of GMM which allows for some control of firm-specific markups by using firm-fixed effects in the TFP estimation. Second, we use the perpetual inventory method to compute the real investment variable, where the depreciation rate of physical capital is based on firms' reported actual depreciation figure rather than arbitrary assumptions. Our TFP estimates are comparable to the existing literature (Brandt et al., 2012; Yu, 2015) using the same data source to estimate the TFP of Chinese manufacturing firms. Then the TFP growth, our proxy for the supply-side investment opportunities, is defined as the log difference of TFP based on all measures.

3.1.2 Demand-side investment opportunities

Measuring demand-side fundamentals is a challenging task. In the absence of firm-level price data, we are unable to estimate a firm-level demand function and compute a firm's idiosyncratic demand level as Foster et al. (2016) and Pozzi and Schivardi (2016) have done. Given the data constraints, we construct four alternative proxies for investment opportunities from the demand side (q^D).

First, we use sales growth as a main measure, which serves to capture consumers' taste shift from the demand side. Sales or sales growth are commonly used in the literature as a proxy for demand (Sharpe, 1994). Blundell et al. (1992) suggest that the state of demand often has a significant impact on the firm-level investment decisions while Tobin's q has less explanatory power. Despite criticism that sales could be highly correlated with cash flow, Bernanke et al. (1999) suggest that sales for small firms are more sensitive to business cycles, so this may reflect non-financial factors. Guiso and Parigi (1999) test the response of investment to demand shocks, where sales growth is used as a proxy for investment opportunities from the demand side. Love and Zicchino (2006) regard sales as a more exogenous variable to measure investment opportunities since they are determined by demand-side factors.

However, sales growth may also reflect factors unrelated to demand. For instance, it may occur because firms are adopting different sales strategies in order to gain a larger market share, even in the absence of demand-side shocks. An improvement of a firm's productivity or product quality may lead to lower sales, but higher net profits. Thus, we construct another three measures apart from sales growth in order to tackle such potential criticisms.

We first construct a variable of excess sales growth, which is defined as sales growth minus the mean value of industry-level sales growth in each year. This measure aims to control for the effect of relative market share,[2] i.e. firms with higher excess sales growth may have a larger market share compared to those with lower excess sales growth. We thus hope this demeaned measure of sales growth can partial out the factors influencing a firm's market share from the demand-side shocks that we want to capture.

Next, we adopt a residual approach to compute the net demand shock by eliminating factors unrelated to the demand from the standard measure of sales growth. We consider two firm-specific factors: size and productivity. Large firms would have advantages over small firms in sales because they can advertise their goods more effectively and have superior logistics systems, more branches, and better customer services. Supply-side factors such as productivity and/or product quality may also contaminate the sales growth as a measure of demand-side shock. For instance, low productivity may prevent firms from meeting the market demand, so their sales do not fully reflect the demand situation in the market. To control for these effects, we estimate the following equation using the panel data fixed effect model:

$$\Delta Sales_{i,t} = a_0 + a_1 Size_{i,t} + a_2 \Delta TFP_{i,t} + \mu_i + \eta_t + \xi_{i,t}, \tag{2}$$

where $\Delta Sales_{i,t}$ is the sales growth of firm i at time t, defined as the log difference between current and lagged actual sales; $Size_{i,t}$ is the natural logarithm of the real total assets of firm

[2] Given the presence of firm entry and exit within the industry in dataset, we can only measure relative market share rather than absolute market share.

i at time t; $\Delta TFP_{i,t}$ is the TFP growth of firm i at time t, where TFP is computed using the ACF approach. Firm-fixed effect (μ_i) and year-fixed effect (η_t) are included. The residual term ($\xi_{i,t}$) is then used to measure the net demand shock by isolating factors other than the demand (such as firm size and productivity) from the sales growth.

Lastly, we use the inventory growth as an inverse proxy for the demand shock, defined as the first difference of inventory stock scaled by tangible fixed capital. The justification is that finished-goods inventories may rise (temporarily) when demand falls. According to Fazzari and Petersen (1993) and Ding et al. (2013), firms may actively adjust their working capital (including inventories) in order to smooth fixed asset investment when facing a negative demand shock. We therefore expect the negative impact of inventory growth on a firm's investment.

3.1.3 Forward-looking investment opportunities

We lastly adopt the forward-looking approach to measure investment opportunities, which is argued to be more fundamental than the backward-looking approach, because investment depends on the future marginal return on capital (Hayashi, 1982; Gilchrist and Himmelberg, 1998; Bond, 2002). We compute the fundamental q (q^F) using the PVAR approach of Gilchrist and Himmelberg (1995), which is the expected present value of profit rates. This approach does not require knowledge of stock market valuation, but 'fundamental information' when measuring investment opportunities (Bontempi et al., 2004).

One novelty of our approach is that we take into account investment opportunities from both the supply- and demand-sides when measuring the marginal q. Let $\boldsymbol{y}_{i,t}$ be a vector comprising a firm's observable growth rates; profit rate (π), TFP growth rate (q^S) and sales growth rate (q^D), i.e. $\boldsymbol{y}_{i,t} = \left(\pi_{i,t}, q^S_{i,t}, q^D_{i,t}\right)'$. We then assume that it follows a stationary first-order autoregressive process:

$$\boldsymbol{y}_{i,t} = \boldsymbol{A}\boldsymbol{y}_{i,t-1} + \boldsymbol{f}_i + \boldsymbol{d}_t + \boldsymbol{u}_{i,t} \tag{3}$$

where $\boldsymbol{f}_i$ is a vector to capture unobservable firm-specific effects, $\boldsymbol{d}_t$ a vector of common aggregate shocks to all firms, and $\boldsymbol{u}_{i,t}$ a vector of disturbance terms orthogonal to $\boldsymbol{y}_{i,t-1}$. Then the conditional expectation of $\boldsymbol{y}_{i,t+s}$ given information set $\boldsymbol{\Omega}_{i,t}$ is obtained by the recursive substitution:

$$\mathbb{E}[\boldsymbol{y}_{i,t+s}|\boldsymbol{\Omega}_{i,t}] = \boldsymbol{A}^s\boldsymbol{y}_{i,t} \tag{4}$$

where $\boldsymbol{f}_i$ and $\boldsymbol{d}_t$ are omitted.

Let $\pi_{i,t} = \boldsymbol{c}_1'\boldsymbol{y}_{i,t}$ where $\boldsymbol{c}_1 = (1,0,0)'$. Then the marginal q is given by the expected present value of $\pi_{i,t}$:

$$
\begin{aligned}
q^F_{i,t} &= \mathbb{E}\left[\sum_{s=1}^{\infty}\beta^s(1-\delta)^s\pi_{i,t+s}|\boldsymbol{\Omega}_{i,t}\right] \\
&= \sum_{s=1}^{\infty}\beta^s(1-\delta)^s\mathbb{E}\left[\pi_{i,t+s}|\boldsymbol{\Omega}_{i,t}\right] \\
&= \boldsymbol{c}_1'\left(\sum_{s=1}^{\infty}\beta^s(1-\delta)^s\boldsymbol{A}^s\right)\boldsymbol{y}_{i,t} \\
&= \boldsymbol{c}'\left[\boldsymbol{I}-\beta(1-\delta)\boldsymbol{A}\right]^{-1}\left[\beta(1-\delta)\boldsymbol{A}\right]\boldsymbol{y}_{i,t}
\end{aligned} \tag{5}
$$

where we set the discount rate and depreciation rate by $\beta = 0.94$ and $\delta = 0.15$ which are identical with the ones in Gilchrist and Himmelberg (1995).

3.2 Baseline model specification

The key research question in this paper is whether and how Chinese firms' investment responds to investment opportunities. Given the widespread capital market imperfections in China, we start from the following reduced-form static investment regression which includes both the financial factor (cash flow) and the fundamental factor (investment opportunities).[3]

$$
\frac{I_{i,t}}{K_{i,t}} = a_0 + a_1 q_{i,t} + a_2\frac{CF_{i,t}}{K_{i,t}} + v_i + v_t + v_j + e_{i,t}, \tag{6}
$$

where $I_{i,t}/K_{i,t}$ is the investment rate, defined as firm i's fixed investment as a proportion of tangible fixed assets at time t; $q_{i,t}$ is used to represent various investment opportunities, which is our research focus; and $CF_{i,t}/K_{i,t}$ is the ratio of cash flow to tangible fixed assets of firm i at time t, where the cash flow is defined as the sum of a firm's net profit and the accumulative depreciation of fixed assets.

To examine firms' heterogeneous responses to investment opportunities, we extend equation (6) by interacting the investment opportunities with ownership dummies, that is, SOE (state-owned firms), PRIV (private firms), FOR (foreign firms) and COL (collective firms), in order to shed light on the impact of the recent institutional reforms discussed in Section 2.3:

$$
\begin{aligned}
\frac{I_{i,t}}{K_{i,t}} = a_0 &+ a_1^{SOE} q_{i,t} * SOE_{i,t} + a_1^{PRIV} q_{i,t} * PRIV_{i,t} + a_1^{FOR} q_{i,t} * FOR_{i,t} \\
&+ a_1^{COL} q_{i,t} * COL_{i,t} + a_2\frac{CF_{i,t}}{K_{i,t}} + v_i + v_t + v_j + e_{i,t}.
\end{aligned} \tag{7}
$$

[3] We opt for the static investment model, because in the literature, investment is found to be lumpy with very low serial correlation (Gomes, 2001), i.e. merely -0.04 in our data.

Both equations (6) and (7) comprise four types of error terms: (*i*) the firm-specific time-invariant effects (v_i), capturing all time-invariant firm characteristics likely to influence fixed investment, and the time-invariant component of the measurement error affecting any of the regression variables; (*ii*) the time-specific effects (v_t), accounting for possible business cycles; (*iii*) the industry-specific effects (v_j), reflecting industrial features associated with firm-level investment; and (*iv*) an idiosyncratic error term ($e_{i,t}$).

3.3 Main identification method

We estimate the linear panel data regression models in equations (6) and (7) using the system GMM estimator due to its advantages of taking into account the possible endogeneity and mismeasurement problems of the explanatory variables.[4] We initially use two lags of all the explanatory variables as instruments in the first-differenced equations of (6) and (7). However, since our models generally fail to reject the test for the second-order autocorrelation of the first-differenced residuals, the levels of the explanatory variables lagged three times are used as instruments for the first-differenced equation and the first-differences of the explanatory variables lagged twice are used as additional instruments for the level equation, that is,

$$\mathbb{E}\left[q_{i,t-s}\Delta e_{i,t}\right] = 0 \text{ and } \mathbb{E}\left[\frac{CF_{i,t-s}}{K_{i,t-s}}\Delta e_{i,t}\right] = 0 \text{ for } s = 3, 4, \ldots, t-1, \tag{8}$$

$$\mathbb{E}\left[\left(v_i + v_j + e_{i,t}\right)\Delta q_{i,t-2}\right] = 0 \text{ and } \mathbb{E}\left[\left(v_i + v_j + e_{i,t}\right)\Delta\frac{CF_{i,t-2}}{K_{i,t-2}}\right] = 0. \tag{9}$$

Note that this selection of instruments is also applied to equation (10).

In assessing whether the instruments employed are legitimate and our models are correctly specified, we employ Hansen's J test of over-identifying restrictions and the m test of nth-order serial correlation in the differenced residuals. Note that Hansen's J test statistic tends to over-reject the null hypothesis of valid instruments due to the instrument proliferation problem in a large panel dataset like ours (Blundell et al., 2000; Roodman, 2009).

[4] GMM has widely been used in both the static and dynamic panel data models, such as Bond (2002); Bloom et al. (2007); Ding et al. (2013).

4 Empirical Analysis

4.1 Data

Our firm-level data comes from the annual accounting reports filed with the National Bureau of Statistics (NBS) by industry firms over the period 1998-2007. The dataset includes all SOEs and other types of enterprises with annual sales above five million yuan (about $750,000). These firms operate in the manufacturing and mining sectors and are located in all 31 Chinese provinces or province-equivalent municipal cities. This dataset is comprehensive, accurate and representative, which represents approximately 90% of gross output in manufacturing and mining sectors in China. The firms are mainly unlisted.[5] Following the literature (Ding et al., 2013, 2016b), we delete observations with negative sales, and those with negative total assets minus total fixed assets, total assets minus liquid assets and accumulated depreciation minus current depreciation. To control for the potential influence of outliers, we exclude observations in the one percent tails of each of the regression variables. Finally, we drop the observations that have no or conflicting records of ownership.[6]

Our final dataset covers 394,060 firms, which corresponds to 1,443,064 firm-year observations. Our sample is unbalanced: the number of firms ranges from a minimum of 98,210 in 1998 to a maximum of 244,046 in 2007.[7] There is entry and exit of firms during our sample period and less than 6 percent of firms have the full 10-year accounting information. The active entry and exit of firms is the consequence of ownership reforms and has been viewed as a source of dynamism in the industrial sector (Brandt et al., 2012).

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

Following Ding et al. (2013, 2016b), we define a firm's ownership based on the majority

[5]Publicly listed companies cannot be separately identified in our dataset, which are estimated as about less than 0.3% of the total number of firms in our sample.

[6]We found 46,372 observations without ownership information and 64 observations with more than two major shareholders.

[7]See Tables B1 and B2 in Appendix B for the detailed structure of the dataset.

average ownership shares,[8] but using the 100% rule[9] as a robustness check. This is because although the latter approach allows us to focus on the *de jure* private firms which are more likely to represent the true private sector, a large number of firms are left in a residual category (referred to as the mixed ownership group), where firms do not have a single-type investor.

Our sample is dominated by private firms: 60% of firms are classified as privately-owned by the majority rule. The proportion of SOEs declines dramatically, from 24% in 1998 to merely 3% in 2007. A similar pattern holds for collective firms, whose share declines from 18% to 4%. In contrast, the share of private firms nearly doubles during the sample period, climbing from 40% in 1998 to 74% in 2007. The share of foreign firms increases slightly from 13% to 15%. This echoes the background information in Section 2.3, according to which China's institutional reforms in the industrial sector led to a declining role for the state sector and a dramatic expansion of the private sector during the period 1998-2007. See Table B3 in Appendix B for details.

4.2 Descriptive statistics

Table 1 reports the summary statistics of key variables. We focus this discussion on means. Fixed asset investment as a proportion of tangible fixed assets averages 12.2% in our sample. The investment rate is lowest for SOEs (6.1%) and highest for private firms (13.9%), followed by foreign firms (12.9%).

Turning to the fundamental factors, among all ownership groups, SOEs have the lowest rates of sales growth (1%), excess sales growth (-9.5%), TFP growth measured by four different methods (3.5% for LP, -2.4% for WLP, 3.6% for ACF and -2.4% for GMM) and the fundamental q (15.1%). By contrast, private firms have the highest rates of sales growth (15.8%), excess sales growth (2.3%), and TFP growth measured by four different methods (13.2% for LP, 8.5% for WLP, 11.3% for ACF and 10.3% for GMM). The average inventory growth is 0.7% for SOEs and 0.8% for private firms. Net demand shock has zero mean value for all ownership groups due to its residual nature. All non-state firms have much higher fundamental q than SOEs.

Regarding financial factors, SOEs have the lowest cash flow ratio (7.0%), whereas foreign firms and private firms have the highest (44.9% and 42.3% respectively). Similar results hold for the liquidity ratio, where SOEs have the lowest and even negative figures (-12%), and all

[8] If the average share of capital paid-in by private investors over the period 1998-2007 is greater than 50%, then the firm is classified as privately owned.

[9] A firm is classified as privately-owned when all the paid-in capital in each year is contributed by private investors.

the other non-state firms have positive liquidity with the highest ratio for foreign firms (13.9%). SOEs have the highest asset tangibility (46.1%), which is much higher than all other non-state firms.

In addition, SOEs are found to be larger and older, and least involved in export. By contrast, private firms and foreign firms are much younger and smaller, and engage more in exports. We also report the *p*-value associated with the *t* test for the equality of means for corresponding variables between SOEs and private firms. They are found to be significantly different in means at the 1% significance level for all variables except for the net demand shock and the inventory growth.

[Table 1 about here.]

4.3 Baseline model

In this section, we estimate equation (6) to investigate the investment-investment opportunity sensitivity of Chinese firms and equation (7) to examine the ownership heterogeneity. We find that the measures of investment opportunities show a large variation across ownership types. Thus, a standard marginal effect does not reasonably reflect this variation. For a fair comparison considering the magnitude of variance across ownership types, we report the marginal effect of one standard deviation increase in the independent variable on the dependent variable and its adjusted standard error in our empirical analysis.[10]

First, we estimate the model with TFP growth which captures investment opportunities from the supply side. We consider four measures estimated by the methods introduced in Section 3.1.1, namely LP, WLP, ACF and GMM in four panels in Table 2. Column [1] reports the estimation results of equation (6). We find that both TFP growth and cash flow have significantly positive effects on investment. This suggests that both the economic fundamentals from the supply side and financial factors are the important determinants of Chinese firms' investment decisions. Column [2] reports the estimation results of equation (7) on firms' heterogeneous responses to supply-side investment opportunities (hereafter q^S for simplicity). The investment of private firms shows the most sensitive response to q^S and it is significantly positive for all TFP measures, that is, one standard deviation increase of q^S is associated with a rise of investment rate by 0.16 (LP) to 0.27 (GMM). The response of SOEs to q^S is also positive for most measures (with an exception for ACF), but the magnitude is much smaller,

[10] We are grateful to a reviewer for suggesting this point. The standard deviation of investment opportunities across the ownership groups can be found in Table 1.

that is, one standard deviation increase of q^S leads to a rise of investment rate by 0.06 (GMM) to 0.08 (WLP). The results of foreign and collective firms are not consistent among various TFP estimates, and the significantly positive effects of q^S on a firm's investment are only found when LP is adopted and the magnitudes are between those of private firms and SOEs. In addition, we test the null hypothesis that 'Firms homogeneously respond to q^S across ownership types' using the Wald test, which is rejected at the 1% significance level. In brief, the results suggest that compared with other ownership groups, private firms care more about supply-side investment opportunities when making investment decisions. Investment by SOEs, to some extent, also responds to supply-side shocks but sensitivity is much weaker.

[Table 2 about here.]

Second, we estimate equations (6) and (7) with investment opportunities from the demand side, which are measured by sales growth, excess sales growth, net demand shock and inventory growth respectively. Table 3 reports the results. In column [1], the estimation results of equation (6) show that a firm's investment is positively related to demand-side investment opportunities (hereafter q^D for simplicity) as proxied by sales growth, excess sales growth and net demand shock, which is in line with the theoretical prediction. As an inverse proxy for q^D, inventory growth is found to have a significant and negative impact on investment, which is consistent with the literature that given the high adjustment costs and the irreversible nature of fixed capital investment, firms would like to actively adjust their working capital (such as inventories) in the face of negative demand shocks in order to smooth fixed investment (Fazzari and Petersen, 1993; Ding et al., 2013). In column [2], when interacting q^D with ownership dummies, we find that the investment of private and foreign firms responds more sensitively to q^D than other ownership types, and the effect is significant for all measures of q^D, that is, one standard deviation increase of q^D is associated with a rise of investment rate by 0.04 (net demand shock) to 0.33 (sales growth) but a decline by 0.16 (inventory growth). For SOEs and collective firms, the effect of q^D on investment is only significantly positive when excess sales growth and net demand shock are adopted, and the magnitude is the lowest for SOEs among all types of ownership, that is, one standard deviation increase of q^D leads to a rise of investment rate by 0.06 (excess sales growth) and 0.01 (net demand shock). The results suggest that demand-side investment opportunities are more important for private and foreign firms, which care more about market demand, and use q^D to form their investment decisions. The Wald test suggests that firms' sensitivities to q^D are significantly different across ownership types. Investment-cash flow sensitivity is positive and significant in all estimations.

[Table 3 about here.]

Lastly, we estimate equations (6) and (7) with the fundamental q (hereafter q^F for simplicity). Since future profits are predicted based on current values, q^F is highly correlated with cash flow and the correlation between these two variables is 0.61. We therefore drop the cash flow term from the regression in order to avoid the multicollinearity problem. The results are reported in Table 4. We find that the investment of all non-state firms responds positively to q^F, indicating that their investment decisions are more concerned with future profits. The marginal effect is highest for the private sector, that is, a one standard deviation increase of q^F is associated with a rise of 0.06 in investment for private firms, whereas the corresponding effect is merely 0.03 for foreign firms and 0.02 for collective firms. By contrast, q^F does not influence the investment decisions of SOEs. The Wald test suggests that sensitivities are statistically different across ownership types.

[Table 4 about here.]

In summary, our baseline results show strong and robust evidence that private firms place more value on investment opportunities from the supply side, demand side and forward-looking profitability. As for SOEs, there is evidence that they take into account investment opportunities (mainly from the supply side) when making investment decisions. However, factors from the demand side and future profitability are less important for SOEs and the overall sensitivity to all types of investment opportunities of SOEs is much lower than that of private firms. This implies that recent SOE reforms such as 'grasp the large, let go of the small' have only been partially successful. Furious competition from the private sector and from new SOEs makes existing SOEs more keen to adopt new technologies and therefore become more efficient from the production side, as shown in Zhu (2012); however, they still enjoy some preferential treatment such as the protected market share in highly monopolistic markets, the greater opportunity to win government procurement contracts and so on (Riedel et al., 2007; Knight and Ding, 2012). This creates significant moral hazard problems, which make SOEs indifferent to market conditions when making investment decisions. Such a loss of information on investment opportunities generates a great deal of inefficiency, making SOEs less efficient than their private counterparts despite their recent improvement from the supply side.

5 Robustness checks

5.1 Firm-specific factors

The inclusion of control variables in the reduced-form investment equation can help predict a firm's investment (Bond and Van Reenen, 2007). Some variables are also useful to control for financial constraints so that we can focus on the investment-investment opportunity sensitivity. Following this line of thinking, we extend our baseline model of equations (6) and (7) by including a number of firm-specific factors as follows:

$$\frac{I_{i,t}}{K_{i,t}} = a_0 + a_1 q_{i,t} + a_2 \frac{CF_{i,t}}{K_{i,t}} + a_3 Tangibility_{i,t} + a_4 Liquidity_{i,t} + a_5 Size_{i,t} + a_6 Age_{i,t}$$
$$+ a_7 Expdum_{i,t} + v_i + v_t + v_j + e_{i,t}, \tag{10}$$
$$\frac{I_{i,t}}{K_{i,t}} = a_0 + a_1^{SOE} q_{i,t} * SOE_{i,t} + a_1^{PRIV} q_{i,t} * PRIV_{i,t} + a_1^{FOR} q_{i,t} * FOR_{i,t} + a_1^{COL} q_{i,t} * COL_{i,t}$$
$$+ a_2 \frac{CF_{i,t}}{K_{i,t}} + a_3 Tangibility_{i,t} + a_4 Liquidity_{i,t} + a_5 Size_{i,t} + a_6 Age_{i,t} + a_7 Expdum_{i,t}$$
$$+ v_i + v_t + v_j + e_{i,t}. \tag{11}$$

where $Tangibility_{i,t}$ is the ratio of the tangible assets to the total assets of firm i at time t; $Liquidity_{i,t}$ is the difference between current assets and current liabilities, normalized by the total assets; $Size_{i,t}$ is the natural logarithm of the real total assets; $Age_{i,t}$ is the natural logarithm of the number of years; and $Expdum_{i,t}$ is equal to one if the firm exports in that year, and zero otherwise. All other variables and the error terms are the same as equations (6) and (7). In the system GMM estimation, the instrument sets are all the explanatory variables (except age) lagged three and four times for the first differenced equation and the first-differenced variables lagged twice for the level equation in order to alleviate the instrument proliferation problem.

Table 5 reports the results of supply-side investment opportunities. After controlling for firm-specific factors, the impact of q^S on the investment remains positive and significant for private firms in all columns. Further, compared to the baseline model, the marginal effects do not change much. An average marginal effect (0.19)[11] is slightly smaller than that of the baseline model (0.22). However, the results of other ownership groups are not consistent across various TFP estimation methods. For instance, the coefficient of SOEs is positive in all columns, but only significant when LP is used for the TFP estimation. This proves our earlier finding that private firms respond more to investment opportunities from the supply side. Note that the

[11] It is the average of four marginal effects.

average marginal effect of private firms is more than six times higher than that of SOEs (0.03).

[Table 5 about here.]

The results of firm-specific control variables are also interesting. First, we find a negative and significant relationship between investment and tangibility. This is consistent with the view of Hovakimian (2009) that firms with a higher asset tangibility are more likely to operate in less dynamic industries with lower growth potential. Second, liquidity is found to have a negative impact on investment. This is in line with the arguments of Riddick and Whited (2009) that firms tend to hold more cash when investment opportunities are bad. According to Ding et al. (2013), high liquidity could alleviate a firm's financial constraints, but could be detrimental to its profitability and thus dampen its investment. Third, we find a positive effect of firm size on investment. This could be explained by Myers and Majluf (1984), who posit that firm size may serve as an inverse proxy for the extent of informational asymmetries between a firm's insiders and external finance providers. Smaller firms are expected to face higher hurdles when raising external capital, whereas large firms, which are assumed to be more diversified and less prone to bankruptcy, can borrow more easily. Fourth, there is a negative link between firm age and investment. Firm age is commonly viewed as another proxy for the wedge between the costs of external and internal capital (Oliner and Rudebusch, 1992). However, in the case of China, although younger firms are more likely to face the problems of asymmetric information and therefore be more financially constrained, younger firms are generally more dynamic and efficient than the old ones. Lastly, the negative impact of export on investment seems puzzling, as, in the international trade literature, exporters are believed be more productive than non-exporters (Bernard and Jensen, 1999). However, Dai et al. (2016) show that processing exporters are less productive than non-processing exporters and non-exporters in China, and have inferior performance in many other aspects such as profitability, wages, R&D and skill intensity. Thus our results may simply reflect the influence of processing trade, which contaminates the performance-enhancing effects of export activities among Chinese firms.

Table 6 reports the results of demand-side investment opportunities. Despite the inclusion of various firm-specific factors, the investment of private firms is found to be significantly responsive to q^D in all columns. Compared to the baseline model, a private firm's investment is less sensitive to the q^D shock for all measures. In particular, it dramatically declines from 0.162 to 0.032 for excess sales growth after controlling for firm-specific factors. The investment of foreign firms is also found to be significantly responsive to q^D for sales growth and net demand shock. However, the results of SOEs and collective firms are not consistent across various measures of q^D. Note that the marginal effect of q^D on investment is the highest for private firms in all columns. All these results confirm the robustness of our findings in the baseline model. The results of all firm-specific control variables are also consistent with our earlier discussion regarding Table 5.

[Table 6 about here.]

Table 7 reports the results of fundamental q. After controlling for firm-specific factors, a firm's investment becomes more sensitive to the fundamental q for all ownership groups. For instance, the marginal effect of SOEs is insignificant at 0.01 in the baseline model, but it becomes significant at 0.03 after controlling firm-specific factors. Moreover, the marginal effect of private firms (0.27) is four times higher than the marginal effect in the baseline model. Note that the marginal effect is the highest for private firms and it is more than eight times higher than that of other ownership groups. In brief, these results are robust and consistent compared to the baseline model.

[Table 7 about here.]

5.2 Exogenous shocks

Despite the advantages of the system GMM estimator in alleviating potential endogeneity bias and mismeasurement problem in the panel data context, we explore the impact of certain exogenous shocks on a firm's investment, using the Difference-in-Difference approach (hereafter DID) in order to further shed light on the robustness of our findings under these exogenous shocks.

We consider two policy shocks which may influence a firm's investment from the supply and demand sides, respectively. First, in 2004/5 the Chinese government announced a plan to redevelop the North-East area (Liaoning, Jilin, Heilongjian and Inner Mongolia), which is referred to as the 'North-East Area Revitalization Plan'. This region is the largest old industrial base of China and is significantly influenced by the past planned economic system. The core of the plan is to revitalize the region's traditional industry through economic reform, structural regulation and regional cooperation. For instance, a value-added tax reform was implemented for this region in July 2004 which generated considerable tax drawback for manufacturing firms and increased their profits. More than 122 loss-making SOEs were forced to shut down during

2004-05 and other SOEs made considerable headway with separating their social functions from their business in order to enhance efficiency. Since the reform aims at increasing the productive efficiency of the industrial sector in the North-East area, something which is out of an individual firm's hands, we regard this event as an exogenous shock from the supply side on firms in this region.

Second, China joined the World Trade Organization (WTO) in December 2001, which is viewed as a milestone for China's opening-up to the global economy and a catalyst for its trade and investment liberalization. China's WTO accession featured the dramatic reduction of tariff and non-tariff barriers, the extension of direct trading rights to more domestic firms, and the liberalization of China's FDI regime. As a result, Chinese firms have gained expanded access to international markets and rapid export growth. We thus regard this event as an exogenous shock from the demand side which increases investment and sales of exporting firms in China.

We employ the DID method to estimate the effect of such exogenous shocks on a firm's investment using the following regression

$$\frac{I_{i,t}}{K_{i,t}} = \alpha + \gamma Treat_i + \lambda Time_t + \delta Treat_i * Time_t + e_{i,t}, \tag{12}$$

where $Treat_i$ is a dummy variable that sets to one if a firm is from the 'treatment group', $Time_t$ a dummy variable that sets to one if an observation is from the 'post-treatment period', and $e_{i,t}$ an error term. Since neither 'policy region' nor 'exporting firms' is perfectly correlated with industries, we control for industry-fixed effects in the regression. Note that the strict exogeneity assumption implies that

$$\begin{aligned}\delta = &\left(\mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 1, Time_t = 1\right] - \mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 1, Time_t = 0\right]\right)\\ &- \left(\mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 0, Time_t = 1\right] - \mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 0, Time_t = 0\right]\right)\end{aligned} \tag{13}$$

is the treatment effect of the exogenous supply/demand shock, and two other parameters,

$$\gamma = \mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 1, Time_t = 0\right] - \mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 0, Time_t = 0\right] \tag{14}$$

$$\lambda = \mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 0, Time_t = 1\right] - \mathbb{E}\left[\frac{I_{i,t}}{K_{i,t}}\middle| Treat_i = 0, Time_t = 0\right] \tag{15}$$

are the difference between the treated and non-treated group in the pre-treatment period and the change after the implementation of policy in the non-treated group, respectively.

First, as for the supply-side shock, firms located in the North-East area are assigned to the treatment group and the treatment period is 2004-05. Following the standard DID framework, we use 1999-2003 for the pre-treatment period and 2006-2007 for the post-treatment period. The DID results for the exogenous supply shock by the North-East revitalization plan are reported in Panel A of Table 8. Full-sample results show that investment in the North-East area was 1.6% lower than in other regions before the plan. However, investment in this region increased by 4.3% ($:= \lambda + \delta$) compared to the pre-treatment period. The increment is also 2% higher than in other regions. Note that investment in the North-East area is 0.4% ($:= \gamma + \delta$) higher than in other regions after the plan. When dividing the sample into different ownership groups, we find the significant (at the 5% level) and positive effects on SOEs and collective firms in the North-East area. In particular, we find strong evidence of a treatment effect for SOEs. In the SOE column, the treatment effect is estimated to be 3%, which is much higher than other ownership groups. The investment of SOEs in the North-East area was 1.2% lower than in other regions before the implementation of the plan. However, it is estimated to be 1.8% higher than in other regions after the plan. We also find similar results in the investment of private firms at the weaker significance level; the treatment effect (0.8%) is significant at the 10% level. Note that the investment of collective firms is still 0.5% lower than in other regions after the plan. Overall, the results show that the North-East revitalization plan improved firms' investment efficiency from the supply side in the North-East area. In particular, the plan was effective in improving the investment efficiency of SOEs in this region, indicating that the original objective of reviving the old state-owned industrial bases in the North East was achieved.

[Table 8 about here]

Next, in terms of the demand-side shock, we assign the exporting firms to the treatment group. Following the recent literature on China's WTO entry (see Liu and Ma, 2016; Brandt et al., 2017; Feng et al., 2017), we use the pre-WTO period (2000-2001) for the pre-treatment period[12] and the post-WTO period (2002-2007) for the post-treatment period. The DID results for the exogenous demand shock are reported in Panel B of Table 8. Full-sample results show that the investment of exporting firms increased by 0.9% compared to the pre-WTO period and the increment is 1.1% higher than non-exporting firms. When dividing the sample into different ownership groups, the significant (at the 5% level) and positive impact on exporting firms by China's WTO accession is only found for private firms: investment increased by 1.9% compared to the pre-WTO period and the increment is 1.1% higher than for non-exporting firms.

[12] Note that there is the lack of identification for the exporting firms in 1998-99.

Therefore, China's WTO accession boosted the investment of exporting firms by improving their demand-side investment opportunities and the effect is strongest for private firms. This is consistent with the view that trade liberalization following China's WTO accession accelerated firm entry and exit in the private sector and contributed to the surge in Chinese exports (Khandelwal et al., 2013; Brandt et al., 2017).

Overall, the findings provide additional support for the validity of our main results.

5.3 Dynamics of investments

Our system GMM regression analysis focuses on the long-run relationship between firms' investment and investment opportunities. However, this approach ignores the dynamics of investment, in other words, short-run dynamics are excluded from the analysis. In order to tackle this issue, we examine the response of firms' investment in various investment opportunities using the panel vector autoregression (hereafter PVAR) model and its impulse response function (hereafter IRF) proposed by Gilchrist and Himmelberg (1998) and Love and Zicchino (2006), where they use the marginal profitability of capital (MPK) and the sales to capital ratio to explain how firms' investment responds to their investment opportunities.

We first estimate the PVAR(1) model:

$$\boldsymbol{x}_{i,t} = \boldsymbol{B}\boldsymbol{x}_{i,t-1} + \boldsymbol{f}_i + \boldsymbol{d}_t + \boldsymbol{u}_{i,t}, \tag{16}$$

where $\boldsymbol{x} = (I/K, q, CF/K)'$, $\boldsymbol{f}_i$ a vector of unobserved firm specific effects, $\boldsymbol{d}_t$ is a vector of common aggregate shocks to all firms, and $\boldsymbol{u}_{i,t}$ a vector of error term orthogonal to $\boldsymbol{x}_{i,t-1}$.

Then the IRFs describe the reaction of one variable to the innovation of another in the system, while holding all other shocks equal to zero.[13] Gilchrist and Himmelberg (1998) suggest that I/K is exogenous and has a contemporaneous impact on MPK and CF/K, but assume that there is no feedback from the MPK shocks to I/K, or from CF/K to MPK. However, Love and Zicchino (2006) assume that MPK is the exogenous variable. They use the sales to capital ratio as the proxy for MPK. They argue that the sales to capital ratio depends on the demand, which is out of a firm's control. The investment is likely to become effective with delay since it requires time to be fully operational. Despite different opinions in ordering, both papers agree that MPK is more exogenous than cash flow. We follow the ordering of Gilchrist

[13] A variable in front is usually assumed to have both contemporaneous and lagged impact on a variable behind, while the latter could have only lagged impact on the former. Hence, variables coming earlier in the system are more exogenous while those appearing later are more endogenous. Both Gilchrist and Himmelberg (1998) and Love and Zicchino (2006) use this ordering, but they put the variables in different sequences.

and Himmelberg (1998) in our analysis.

The IRFs trace the effects of unexpected shocks on endogenous variables in the PVAR system. However, since the shocks are correlated across equations, there would be an identification problem when we interpret IRFs. To avoid this problem, we isolate shocks to one of the variables in the system using the Choleski decomposition. We use this orthogonal IRFs for our empirical analysis.

Figure 1 plots the response of firms' investment to the unit q^S shock. At the first year, all firms respond positively to it for all TFP estimates. Their responses are significant by the 95% confidence intervals. The investment of private firms shows the highest sensitivity to all types of q^S shocks, but the difference seems to be small compared with SOEs and foreign firms. In particular, it is interesting to find that SOEs respond fairly actively to the q^S shock when making their investment decisions despite their relatively lower TFP growth rates.

[Figure 1 about here.]

Next, Figure 2 plots the response of firms' investment to the unit q^D shock. At the first year, the investment is shown to have a positive response to the sales growth shock except for SOEs. The IRFs of all non-state firms are significant by the 95% confidence intervals. This is also consistently found in the excess sales growth and the net demand shock. Interestingly, all firms negatively respond to the inventory growth shock at time zero and the effects have disappeared after a year.[14] We cannot find any significant difference across ownership types.

[Figure 2 about here.]

Finally, Figure 3 plots the response of firms' investment to the unit q^F shock. Since it is a forward-looking variable, it has a contemporaneous impact on firms' investment decisions. We find that the investments of all firms positively respond to the shock at time zero and the effects diminish steadily. SOEs have the lowest sensitivity compared to their non-state counterparts. All IRFs appear to be statistically significant by the 95% confidence intervals.

[Figure 3 about here.]

In sum, we find that the investment of non-state firms responds positively to all types of investment opportunity shocks except for the inventory growth shock (negative responses).

[14] Inventory growth can also be considered as an inventory investment and it is contemporaneously determined along with investment by firms. Hence, it responds to the shock at time zero.

The investment of SOEs responds positively to the q^S shock and the q^F shock, but not to the q^D shock. This suggests that SOEs fail to take into account demand-side investment opportunities when making investment decisions. Overall, the results of dynamic short-run analysis are consistent with our key results from the static long-run analysis.

5.4 Financial market development

According to Wurgler (2000), financial development may help a country take better advantage of its investment opportunities, improve the allocation of capital and enhance overall investment efficiency. On the one hand, financial development can produce more information ex ante about possible investments, help firms identify good investment opportunities and reallocate capital to more productive use. On the other hand, financial development can monitor investment and exert corporate governance after providing finance. Besides, financial development can facilitate trading, diversification, and management of risk, mobilize and pool savings and ease the exchange of goods and services (Levine, 2005). Following this line of thinking, we investigate whether firms' investment is more responsive to investment opportunities in regions with better financial development and whether there is any heterogeneity among different ownership groups or when different measures of investment opportunities are adopted. We split our sample into two groups by the 'financial market development index (FMDI)' published by Gang et al. (2003). Provinces with a FMDI above the median value are classified as 'High FMDI', and those with a FMDI below the median value are classified as 'Low FMDI'.[15]

Table 9 reports the results of supply-side investment opportunities. The significant and positive effect of q^S on investment is mainly found for private firms, with a bigger marginal effect for those located in regions with better financial development. The average marginal effect (0.34) in regions with better financial development is 70% higher than that in regions where it is poor. As for SOEs, the impact of q^S on investment is significantly positive only when LP and ACF are adopted to construct the TFP, but the marginal effect is higher for firms located in regions with low financial development. The average marginal effect is 0.06 in regions with better financial development, while it is 0.11 in those where it is poor. This contrasting pattern indicates that financial development helps private firms better identify investment opportunities and improves their investment efficiency; on the other hand, the limited impact of financial development on SOEs' investment efficiency may result from the problems discussed in Section 2.3.

[15]See Appendix C for detailed province classification, where 16 provinces are classified as the 'High' group and 15 provinces are classified as the 'Low' group.

[Table 9 about here.]

Table 10 reports the results of demand-side investment opportunities. We find that financial development improves investment efficiency mainly for private and foreign firms, in other words, the investment of private and foreign firms is more responsive to all types of q^D shocks in regions with better financial development while its response is mostly insignificant in regions with poor financial development. There is some similar evidence for SOEs and collective firms, but the results are not consistent across different q^D measures.

[Table 10 about here.]

Table 11 reports the results of forward-looking investment opportunities. We find that investment of all domestic firms, except foreign firms, responds more sensitively to investment opportunities in regions with low financial development. The average marginal effect (0.07) in regions with low financial development is more than double that in regions where it is high. The results are not entirely surprising, as the fundamental q is highly correlated with cash flow, i.e. firms' investment can be very sensitive to their cash flow when their access to external finance is limited in regions with low financial development.[16] The coefficient of foreign firms in regions with low financial development is insignificant, which might be due to the fact that most foreign firms are located in provinces which are more highly developed financially.

[Table 11 about here.]

Overall, our results suggest that financial market development only improves the investment efficiency of private firms, as investment opportunities from all dimensions (supply side, demand side and future profitability) can be well identified and responded to. Thus, our results support the conventional view of China's financial reforms as discussed in Section 2.3, and call for further financial sector reforms in order to expand the benefit to SOEs and other ownership groups.

6 Conclusion

In this paper, we have explored the important research question of whether and how firms' investment decisions respond to various components of economic fundamentals in China, a subject

[16] We notice that there is pertinent prior work by Cumming and Wu (2016). They examine how the response of innovation investment to private debt varies with the degree of political instability in China. They find that the impact of private debt on innovation investment is less pronounced in regions with greater political instability.

which has been largely ignored in the literature. Given the background of dramatic institutional changes during the sample period, we have focused on ownership heterogeneity. Compared with all other ownership groups, private firms care more about investment opportunities from the supply side, demand side, and future profitability. This explains the high investment rate and investment efficiency of the private sector, which contributes to the rapid economic growth in China. By contrast, recent institutional reforms such as 'grasp the large, let go of the small' have only partially transformed SOEs, leading them to care about investment opportunities from the supply side and exhibit positive TFP growth. However, the fact that SOEs continue to play a major role in several monopolistic sectors has undermined their incentive to incorporate demand-side factors and future profitability into their investment decisions, which has jeopardized their investment efficiency. Financial sector development has helped private firms take better advantage of their investment opportunities and enhance their investment efficiency, but this has been much less the case for other ownership groups.

Our findings have important policy implications for China's economic growth and institutional and financial sector reforms. First, Chinese policymakers could stimulate corporate investment and growth through various channels. For instance, whereas demand-side policies could be more effective to enhance the investment momentum of private firms, governments could encourage SOEs to invest more in R&D and new technologies in order to increase their fixed capital investment. Second, further financial sector reforms could aim at improving the flow of formal finance to the private sector and reducing the availability of low-cost capital to SOEs. This could stimulate economic growth by channeling financial resources towards more efficient use and mitigating the problems of inefficient investment and overcapacity. Lastly, it is important to confine the role of SOEs to the provision of public goods in strategic industries such as national defence and key infrastructure, and retreat in all other competitive sectors, which will reduce the degree of government intervention in businesses and boost overall investment efficiency and investor confidence.

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Table 1: Summary statistics of key variables

Variable	Full sample	SOEs	Private	Foreign	Collective	Diff
I/K	0.122	0.061	0.139	0.129	0.097	-0.078***
	[0.376]	[0.326]	[0.393]	[0.341]	[0.371]	
q^S (LP)	0.107	0.035	0.132	0.107	0.053	-0.097***
	[0.686]	[0.727]	[0.664]	[0.736]	[0.662]	
$q^S(WLP)$	0.066	-0.024	0.085	0.068	0.027	-0.109***
	[0.431]	[0.543]	[0.415]	[0.404]	[0.437]	
q^S (ACF)	0.097	0.036	0.113	0.085	0.056	-0.077***
	[0.696]	[0.772]	[0.684]	[0.740]	[0.686]	
q^S (GMM)	0.078	-0.024	0.103	0.076	0.033	-0.127***
	[0.436]	[0.546]	[0.417]	[0.415]	[0.444]	
q^D $(Sales\ growth)$	0.126	0.010	0.158	0.125	-0.043	0.148***
	[0.446]	[0.494]	[0.442]	[0.427]	[0.430]	
q^D $(Excess\ sales\ growth)$	0.000	-0.095	0.023	0.002	-0.043	0.118***
	[0.446]	[0.494]	[0.442]	[0.427]	[0.430]	
q^D $(Net\ demand\ shock)$	0.000	0.000	0.000	0.000	0.000	0.000
	[0.371]	[0.449]	[0.362]	[0.353]	[0.377]	
q^D $(Inventory\ growth)$	0.017	0.007	0.008	0.066	-0.002	-0.001
	[0.919]	[0.654]	[0.924]	[1.013]	[0.916]	
q^F	0.425	0.151	0.425	0.545	0.638	-0.274***
	[0.766]	[0.567]	[0.692]	[0.888]	[1.065]	
CF/K	0.385	0.070	0.423	0.449	0.409	-0.353***
	[0.754]	[0.424]	[0.752]	[0.861]	[0.815]	
$Liquidity$	0.051	-0.120	0.051	0.139	0.055	-0.171***
	[0.341]	[0.461]	[0.303]	[0.320]	[0.354]	
$Tangibility$	0.364	0.461	0.357	0.323	0.351	0.104***
	[0.214]	[0.226]	[0.211]	[0.195]	[0.211]	
$Size$	9.710	10.031	9.529	10.337	9.431	0.502***
	[1.470]	[1.929]	[1.348]	[1.393]	[1.271]	
Age	9.606	25.694	7.215	6.526	14.652	18.479***
	[11.242]	[17.180]	[8.802]	[4.234]	[11.698]	
$Expdum$	0.272	0.130	0.214	0.679	0.137	-0.084***
	[0.445]	[0.337]	[0.410]	[0.466]	[0.343]	
Observations	1,443,064	161,716	862,269	216,754	143,667	

Notes: This table reports sample means and standard deviations. The standard deviations are in brackets. See Appendix C for detailed variable definitions. The column 'Diff' reports a differences in means of corresponding variables between SOEs and private firms ($\mathbb{E}[SOEs] - \mathbb{E}[Private]$) associated with the results of t-test on the equality of means. *** indicates significance at the 1% level.

Table 2: Supply-side investment opportunities (q^S)

	Panel A LP		Panel B WLP		Panel C ACF		Panel D GMM	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
q^S	0.218***		0.251***		0.214*		0.234***	
	(0.019)		(0.025)		(0.127)		(0.021)	
$q^S * SOE$		0.064***		0.075***		0.042		0.060***
		(0.015)		(0.024)		(0.039)		(0.007)
$q^S * PRIV$		0.162***		0.250***		0.208***		0.271***
		(0.026)		(0.026)		(0.055)		(0.033)
$q^S * FOR$		0.091***		0.033		0.017		0.058
		(0.022)		(0.021)		(0.031)		(0.058)
$q^S * COL$		0.084***		-0.006		-0.068		-0.127
		(0.020)		(0.026)		(0.043)		(0.089)
CF/K	0.082***	0.083***	0.075***	0.080***	0.108***	0.089***	0.073***	0.082***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.006)	(0.007)	(0.009)
Wald test		0.000		0.000		0.000		0.000
AR(1) test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(3) test	0.537	0.812	0.404	0.241	0.635	0.554	0.787	0.478
J test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,347,764	1,347,764	865,415	865,415	865,903	865,903	865,415	865,415

Notes: This table reports the marginal effects of the supply-side investment opportunities by the system GMM. The marginal effect is calculated by the coefficient times standard deviation of independent variable to reflect different magnitudes across the ownership types. The standard errors of marginal effects are reported in the parentheses. See Appendix C for detailed variable definitions. Column [1] reports the results of equation (6) and Column [2] reports the results of equation (7) which interacts the investment opportunities with ownership dummies, i.e. SOE (state-owned firms), PRIV (private firms), FOR (foreign firms) and COL (collective firms). 'Year dummy' and 'Industry dummy' are included but not reported. We use the levels of explanatory variables lagged three times and more as instruments for the first-differenced equation. 'Wald test' is the test for the null of 'The impact of supply-side investment opportunities on firm's investment is the same across ownership types'. 'AR(n) test' is the test for the null of 'No n-th order autocorrelation of the differenced residuals', and 'J test' is the Hansen test of 'Over-identifying restrictions'. We report p-values for these specification tests. *, ** and *** indicate the significance of coefficients at the 10%, 5% and 1% level respectively.

Table 3: Demand-side investment opportunities (q^D)

	Panel A Sales growth		Panel B Excess sales growth		Panel C Net demand shock		Panel D Inventory growth	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
q^D	0.375***		0.218***		0.039***		-0.026**	
	(0.029)		(0.019)		(0.001)		(0.011)	
$q^D * SOE$		0.049		0.064***		0.006***		-0.041
		(0.050)		(0.015)		(0.002)		(0.041)
$q^D * PRIVV$		0.331***		0.162***		0.037***		-0.160**
		(0.030)		(0.026)		(0.005)		(0.074)
$q^D * FOR$		0.143***		0.091***		0.015***		-0.022**
		(0.020)		(0.022)		(0.004)		(0.009)
$q^D * COL$		0.020		0.084***		0.012***		-0.001
		(0.051)		(0.020)		(0.004)		(0.017)
CF/K	0.074***	0.082***	0.082***	0.083***	0.109***	0.109***	0.112***	0.091***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.007)	(0.008)
Wald test		0.000		0.000		0.000		0.000
AR(1) test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(3) test	0.635	0.554	0.537	0.812	0.333	0.545	0.234	0.183
J test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,239,204	1,239,204	1,239,204	1,239,204	795,132	795,132	819,901	819,901

Notes: This table reports the marginal effects of the demand-side investment opportunities by the system GMM. 'Wald test' is a test for the null of 'The impact of demand-side investment opportunities on firm's investment is the same across ownership types'. See notes of Table 2 for other information.

Table 4: Forward-looking investment opportunities (q^F)

	[1]	[2]
q^F	0.063***	
	(0.01)	
$q^F * SOE$		0.007
		(0.010)
$q^F * PRIV$		0.058***
		(0.007)
$q^F * FOR$		0.026***
		(0.007)
$q^F * COL$		0.021***
		(0.007)
Wald test		0.000
AR(1) test	0.000	0.000
AR(3) test	0.921	0.917
J test	0.000	0.000
Year dummy	Yes	Yes
Industry dummy	Yes	Yes
Observations	432,325	432,273

Notes: This table reports the marginal effects of the forward-looking investment opportunities by the system GMM. 'Wald test' is a test for the null of 'The impact of fundamental q on firm's investment is the same across ownership types'. See notes of Table 2 for other information.

Table 5: Supply-side investment opportunities (q^S) with firm-specific factors

	Panel A LP		Panel B WLP		Panel C ACF		Panel D GMM	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
q^S	0.220***		0.125***		0.207***		0.127***	
	(0.014)		(0.008)		(0.053)		(0.008)	
$q^S * SOE$		0.045***		0.032		0.014		0.024
		(0.011)		(0.023)		(0.012)		(0.020)
$q^S * PRIV$		0.177***		0.185***		0.209***		0.192***
		(0.035)		(0.042)		(0.030)		(0.041)
$q^S * FOR$		0.142***		0.008		0.153**		0.010
		(0.023)		(0.026)		(0.069)		(0.029)
$q^S * COL$		0.054		0.061		-0.097		0.011
		(0.034)		(0.069)		(0.101)		(0.069)
CF/K	0.089***	0.106***	0.080***	0.079***	0.104***	0.091***	0.077***	0.075***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.015)	(0.010)	(0.010)
$Tangibility$	-0.063***	-0.052***	-0.056***	-0.062***	-0.044***	-0.072***	-0.059***	-0.065***
	(0.007)	(0.009)	(0.008)	(0.009)	(0.010)	(0.016)	(0.008)	(0.009)
$Liquidity$	-0.013**	-0.015*	-0.018**	-0.018***	-0.023***	-0.018	-0.018***	-0.015*
	(0.006)	(0.008)	(0.008)	(0.008)	(0.008)	(0.012)	(0.008)	(0.008)
$Size$	0.055***	0.039***	0.041***	0.042***	0.278***	0.043***	0.036***	0.035***
	(0.005)	(0.015)	(0.006)	(0.007)	(0.0502)	(0.009)	(0.006)	(0.007)
Age	-0.015***	-0.005	-0.017***	-0.016***	-0.002***	0.006	-0.014***	-0.011***
	(0.002)	(0.004)	(0.002)	(0.003)	(0.000)	(0.004)	(0.002)	(0.003)
$Expdum$	-0.045***	-0.032***	-0.016	-0.012	-0.075***	0.002	-0.014	-0.005
	(0.012)	(0.012)	(0.012)	(0.013)	(0.028)	(0.020)	(0.012)	(0.013)
Wald test		0.000		0.000		0.000		0.000
AR(1) test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(3) test	0.434	0.928	0.518	0.737	0.207	0.626	0.430	0.233
J test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	803,379	802,954	619,147	619,147	615,043	615,043	619,147	619,147

Notes: This table reports the marginal effects of the supply-side investment opportunities with firm-specific factors by the system GMM. Column [1] reports the results of equation (10) and Column [2] reports the results of equation (11) which interacts the investment opportunities with ownership dummies. We use the levels of explanatory variables (except *Age*) lagged three and four times for the first-differenced equation and the first-differenced variables lagged twice for the level equation. See notes of Table 2 for other information.

Table 6: Demand-side investment opportunities (q^D) with firm-specific factors

	Panel A Sales growth		Panel B Excess sales growth		Panel C Net demand shock		Panel D Inventory growth	
	[1]	[2]	[1]	[2]	[1]	[2]	[1]	[2]
q^D	0.038***		0.006		0.034***		-0.138***	
	(0.006)		(0.017)		(0.015)		(0.001)	
$q^D * SOE$		-0.015		-0.035*		0.006***		-0.033
		(0.020)		(0.019)		(0.002)		(0.028)
$q^D * PRIVV$		0.196***		0.032***		0.030***		-0.139***
		(0.022)		(0.012)		(0.003)		(0.047)
$q^D * FOR$		0.034***		0.013		0.007***		-0.017
		(0.013)		(0.013)		(0.003)		(0.011)
$q^D * COL$		0.018		0.031*		0.008***		-0.011
		(0.015)		(0.016)		(0.003)		(0.010)
CF/K	0.092***	0.081***	0.095***	0.087***	0.106***	0.106***	0.077***	0.079***
	(0.008)	(0.010)	(0.009)	(0.009)	(0.010)	(0.011)	(0.010)	(0.010)
Tangibility	-0.063***	-0.057***	-0.027***	-0.039***	-0.057***	-0.052***	-0.029***	-0.030***
	(0.006)	(0.008)	(0.008)	(0.009)	(0.009)	(0.010)	(0.006)	(0.007)
Liquidity	-0.021***	-0.012	-0.027***	-0.019***	-0.017*	-0.017*	-0.018***	-0.020***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)	(0.009)	(0.007)	(0.007)
Size	0.046***	0.038***	0.032***	0.045***	0.044***	0.046***	0.042***	0.043***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)
Age	-0.011***	-0.005*	-0.087***	-0.076***	-0.015***	-0.021***	-0.083***	-0.085***
	(0.000)	(0.003)	(0.007)	(0.007)	(0.002)	(0.002)	(0.004)	(0.004)
Expdum	-0.027***	0.007	-0.004	-0.014	-0.006	-0.006	0.005	0.006
	(0.010)	(0.011)	(0.011)	(0.009)	(0.013)	(0.012)	(0.011)	(0.011)
Wald test		0.000		0.000		0.000		0.000
AR(1) test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(3) test	0.581	0.944	0.227	0.448	0.716	0.842	0.439	0.398
J test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	919,028	918,551	918,551	918,551	568,326	568,326	583,021	583,021

Notes: This table reports the marginal effects of the demand-side investment opportunities with firm-specific factors by the system GMM. See notes of Table 2 and 5 for other information.

Table 7: Forward-looking investment opportunities (q^F) with firm-specific factors

	[1]	[2]
q^F	0.071***	
	(0.004)	
$q^F * SOE$		0.030***
		(0.008)
$q^F * PRIV$		0.266***
		(0.015)
$q^F * FOR$		0.035**
		(0.014)
$q^F * COL$		0.030***
		(0.008)
$Tangibility$	-0.048***	-0.041***
	(0.005)	(0.008)
$Liquidity$	-0.019***	-0.049***
	(0.006)	(0.009)
$Size$	0.055***	0.024***
	(0.006)	(0.008)
Age	-0.025***	-0.005**
	(0.001)	(0.002)
$Expdum$	-0.012	-0.001
	(0.01)	(0.014)
Wald test		0.000
AR(1) test	0.000	0.000
AR(3) test	0.518	0.737
J test	0.000	0.000
Year dummy	Yes	Yes
Industry dummy	Yes	Yes
Observations	294,396	294,357

Notes: This table reports the marginal effects of the forward-looking investment opportunities with firm-specific factors by the system GMM. See notes of Table 2 and 5 for other information.

Table 8: Exogenous supply and demand shocks

	FULL	SOE	PRIV	FOR	COL
Panel A. North-East area revitalization in 2004-2005					
Treat (γ)	-0.016***	-0.012***	0.000	0.010	-0.026***
	(0.002)	(0.004)	(0.004)	(0.006)	(0.006)
Time (λ)	0.023***	-0.001	0.016***	0.001	0.016***
	(0.001)	(0.003)	(0.001)	(0.002)	(0.003)
$Treat * Time$ (δ)	0.020***	0.030***	0.008*	-0.005	0.021**
	(0.003)	(0.009)	(0.005)	(0.010)	(0.011)
Industry Dummy	Yes	Yes	Yes	Yes	Yes
R^2	0.048	0.047	0.049	0.041	0.039
Observations	707,690	77,112	418,746	111,682	70,606
Panel B. Chian's WTO accession in December 2001					
Treat (γ)	0.005***	-0.039***	0.013***	0.017***	-0.010***
	(0.001)	(0.003)	(0.001)	(0.004)	(0.003)
Time (λ)	-0.002	0.005	0.008***	0.005	-0.005
	(0.001)	(0.005)	(0.002)	(0.003)	(0.005)
$Treat * Time$ (δ)	0.011***	-0.002	0.011***	0.004*	0.000
	(0.002)	(0.007)	(0.002)	(0.002)	(0.008)
Industry Dummy	Yes	Yes	Yes	Yes	Yes
R^2	0.003	0.002	0.008	0.009	0.006
Observations	920,674	79,360	571,456	163,247	73,014

Notes: This table reports the results of the difference-in-difference (DID) estimation in equation (12). The standard errors of estimated coefficients are reported in the parentheses. In Panel A, the firms located in the North-East area are assigned to the treatment group (*Treat*) and we use 1999-2003 for the pre-treatment period and 2006-2007 for the post-treatment period (*Time*). In Panel B, the exporting firms are assigned to the treatment group (*Treat*) and we use the pre-WTO period (2000-2001) for the pre-treatment period due to lack of identification for exporting firms in 1998-1999 and the post-WTO period (2002-2007) for the post-treatment period (*Time*). *, ** and *** indicate the significance of coefficients at the 10%, 5% and 1% level respectively.

Table 9: Supply-side investment opportunities (q^S) and financial market development

	A. LP		B. WLP		C. ACF		D. GMM	
	High	Low	High	Low	High	Low	High	Low
$q^S * SOE$	0.056*	0.128**	0.002	0.010	0.015	0.210*	0.039	0.080
	(0.029)	(0.057)	(0.003)	(0.072)	(0.014)	(0.108)	(0.028)	(0.077)
$q^S * PRIV$	0.340***	0.219***	0.337***	0.182	0.405***	0.218	0.279	0.194**
	(0.032)	(0.072)	(0.036)	(0.176)	(0.142)	(0.140)	(0.323)	(0.085)
$q^S * FOR$	0.041**	-0.001	-0.034	0.074	0.011	0.006	-0.031	-0.017
	(0.020)	(0.046)	(0.059)	(0.062)	(0.049)	(0.067)	(0.067)	(0.015)
$q^S * COL$	0.081**	0.005	0.08	0.042	0.077	0.066	0.153	0.056
	(0.036)	(0.049)	(0.074)	(0.288)	(0.132)	(0.102)	(0.247)	(0.054)
CF/K	0.108***	0.166***	0.080***	0.166***	0.121***	0.165***	0.067***	0.144***
	(0.009)	(0.032)	(0.014)	(0.044)	(0.012)	(0.034)	(0.012)	(0.042)
Wald test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(1) test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(3) test	0.373	0.449	0.528	0.127	0.481	0.564	0.980	0.885
J test	0.000	0.264	0.000	0.092	0.001	0.306	0.002	0.993
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	971,749	160,526	752,593	112,822	743,119	122,784	752,593	112,822

Notes: This table reports the marginal effects of the supply-side investment opportunities for the different degrees of financial market development by the system GMM. 'High' and 'Low' are classified by the 'financial market development index'. 'Wald test' is a test for the null of 'The impact of supply-side investment opportunities on the investment is the same across ownership types'. See notes of Table 2 for other information.

Table 10: Demand-side investment opportunities (q^D) and financial market development

	A.Sales growth		B.Excess sales growth		D.Net demand shock		C.Inventory growth	
	High	Low	High	Low	High	Low	High	Low
$q^D * SOE$	0.037**	-0.019	0.068***	0.053	0.006	0.010	-0.034	-0.044
	(0.018)	(0.046)	(0.015)	(0.055)	(0.010)	(0.020)	(0.039)	(0.029)
$q^D * PRIV$	0.224***	0.134***	0.097***	0.076	0.040***	0.034*	-0.269**	-0.045*
	(0.015)	(0.050)	(0.025)	(0.089)	(0.009)	(0.018)	(0.106)	(0.026)
$q^D * FOR$	0.081***	-0.005	0.089***	0.053	0.016***	0.004	-0.025**	0.025
	(0.012)	(0.022)	(0.021)	(0.042)	(0.004)	(0.025)	(0.010)	(0.042)
$q^D * COL$	0.032**	-0.033	0.134***	0.022	0.012***	0.011	-0.004	-0.021
	(0.015)	(0.034)	(0.025)	(0.030)	(0.005)	(0.011)	(0.017)	(0.052)
CF/K	0.082***	0.113***	0.080***	0.117***	0.111***	0.125***	0.085***	0.134***
	(0.007)	(0.024)	(0.008)	(0.029)	(0.010)	(0.003)	(0.010)	(0.028)
Wald test	0.000	0.000	0.000	0.866	0.000	0.000	0.000	0.342
AR(1) test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(3) test	0.455	0.302	0.899	0.809	0.157	0.434	0.225	0.777
J test	0.000	0.120	0.000	0.008	0.000	0.743	0.000	0.580
Time dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,148,823	198,941	1,148,823	198,941	703,610	103,296	705,911	113,990

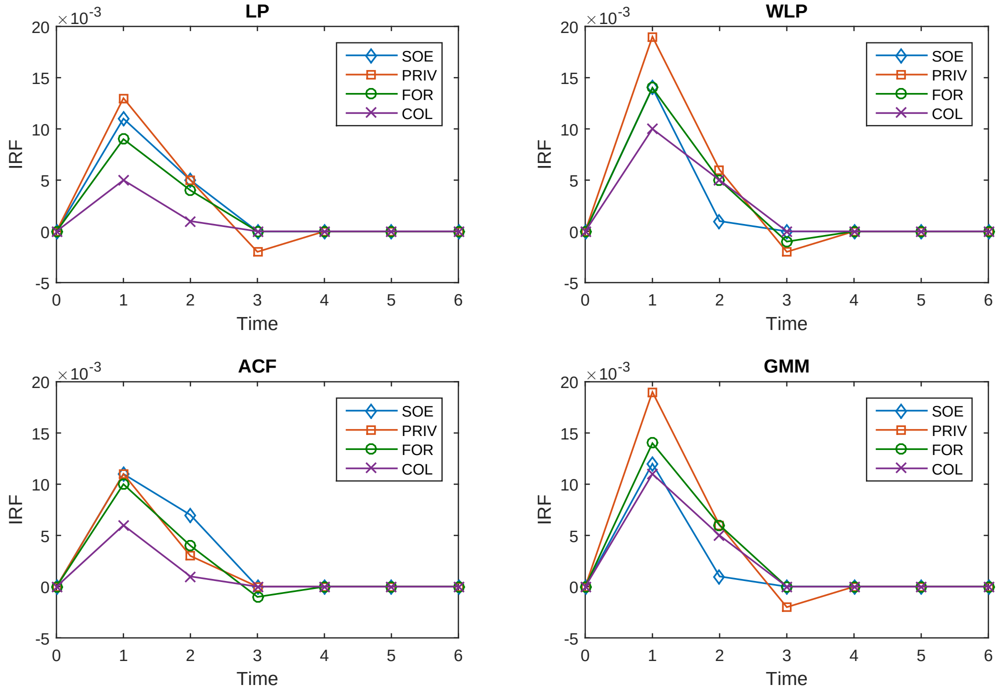
Notes: This table reports the marginal effects of the demand-side investment opportunities for the different degrees of financial market development by the system GMM. 'Wald test' is a test for the null of 'The impact of demand-side investment opportunities on the investment is the same across ownership types'. See notes of Table 2 and 9 for other information.

Table 11: Forward-looking investment opportunities (q^F) and financial market development

	High	Low
$q^F * SOE$	0.012***	0.031**
	(0.005)	(0.014)
$q^F * PRIV$	0.046***	0.136*
	(0.011)	(0.071)
$q^F * FOR$	0.020**	-0.001
	(0.009)	(0.018)
$q^F * COL$	0.019***	0.036***
	(0.007)	(0.013)
Wald test	0.000	0.000
AR(1) test	0.000	0.000
AR(3) test	0.552	0.184
J test	0.000	0.271
Time dummy	Yes	Yes
Industry dummy	Yes	Yes
Observations	373,491	58,780

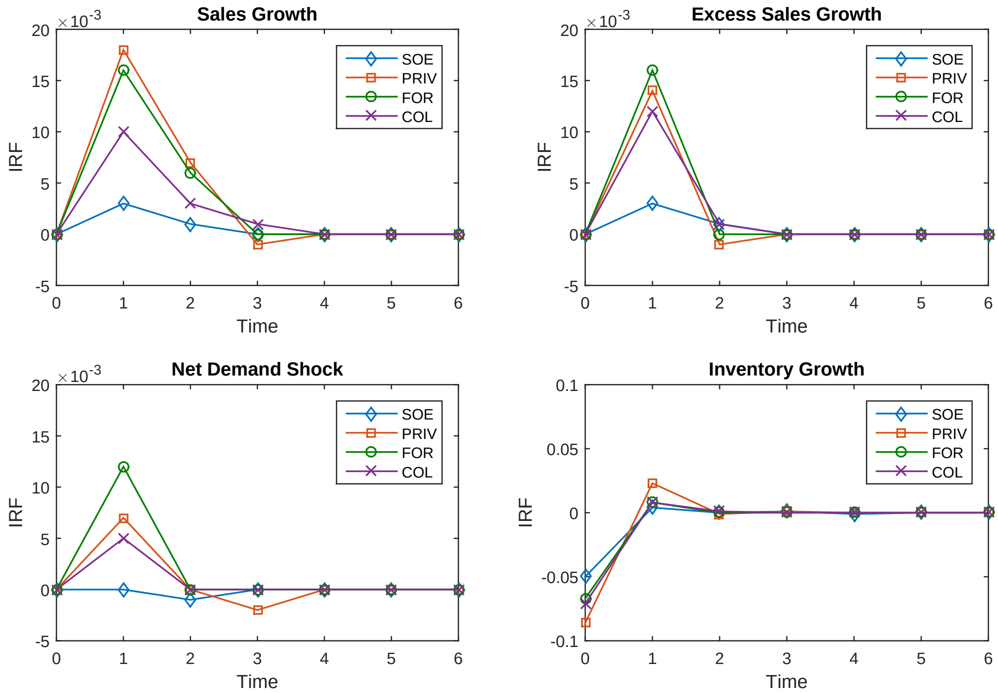
Notes: This table reports the marginal effects of the forward-looking investment opportunities for the different degrees of financial market development by the system GMM. 'Wald test' is a test for the null of 'The impact of the fundamental q on the investment is the same across ownership types'. See notes of Table 2 and 9 for other information.

Figure 1: Response of investment to the unit q^S shock



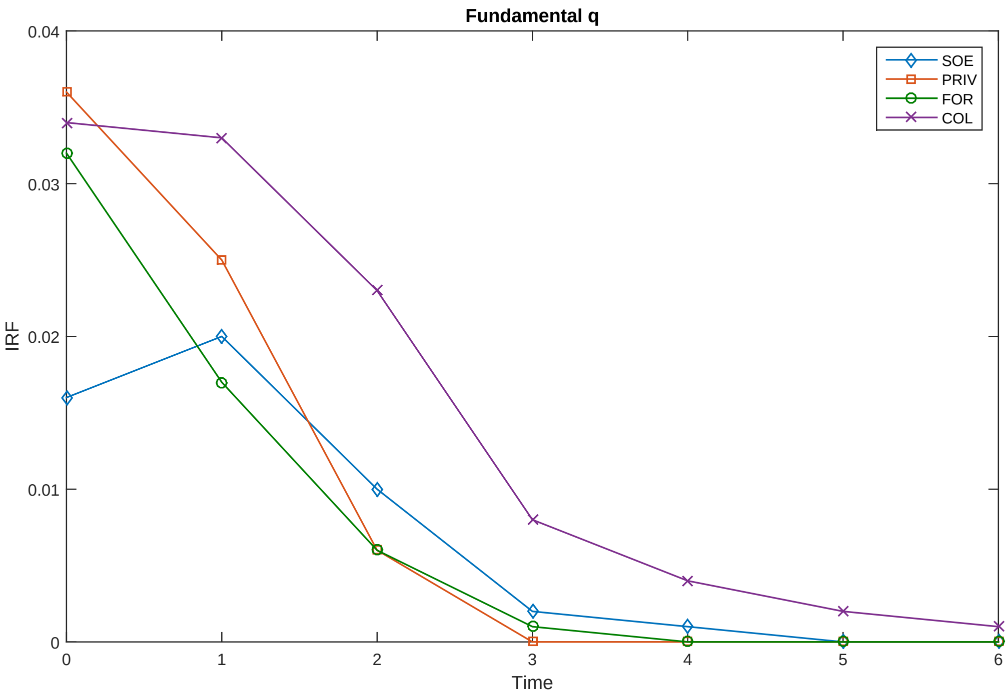
Note: We estimate PVAR(1) in equation (16) with three variables: I/K, q^S and CF/K. We use TFP growth, estimated by LP, WLP, ACF and GMM, as the measurement of supply-side investment opportunities. We plot the orthogonalized IRFs of investment to the unit q^S shock for each ownership over the six-year horizons.

Figure 2: Response of investment to the unit q^D shock



Note: We estimate PVAR(1) in equation (16) with three variables: I/K, q^D and CF/K. We use sales growth, excess sales growth, net demand shock and inventory growth as the measurement of demand-side investment opportunities. We plot the orthogonalized IRFs of firm's investment to the unit q^D shock for each ownership over the six-year horizons.

Figure 3: Response of investment to the unit q^F shock



Note: We estimate PVAR(1) in equation (16) with three variables: I/K, q^F and CF/K. We use fundamental q as the measurement of forward-looking investment opportunities. We plot the orthogonalized IRFs of firm's investment to the unit q^F shock for each ownership over the six-year horizons.

Appendix A A theoretical model on investment opportunities

Starting from a basic investment model, we assume that firm value is given by the expected sums of discounted future net revenues

$$V_{i,t} = \mathbb{E}_t \left[\sum_{s=0}^{\infty} \beta^s \Pi_{i,t+s} \right], \tag{A.1}$$

where $\Pi_{i,t}$ is the net revenue of firm i at time t and β is the constant discount rate.

Following the neoclassical investment theory, we assume that adjustment costs are convex and increasing in I/K. Thus the capital adjustment cost takes the form of

$$G(I_{i,t}, K_{i,t}) = \frac{g}{2} \left[\frac{I_{i,t}^2}{K_{i,t}} - a \right], \tag{A.2}$$

where g denotes the adjustment cost. Firm's net revenue function is therefore given by

$$\Pi_{i,t}(K_{i,t}, I_{i,t}) = p_t \left[F(K_{i,t}) - G(K_{i,t}, I_{i,t}) \right] - p_t^k I_{i,t}, \tag{A.3}$$

where $F(K_{i,t})$ is the production function, p_t the price of output and p_t^k the price of capital goods.

The capital accumulation constraint is given by

$$I_{i,t} = K_{i,t} - (1-\delta) K_{i,t-1}, \tag{A.4}$$

where $I_{i,t}$ is an investment at time t, $K_{i,t}$ and $K_{i,t-1}$ capital stock at time t and $t-1$, and δ the constant rate of depreciation.

Assume that firms are price takers and $F(K_{i,t})$ and $G(K_{i,t}, I_{i,t})$ generate a constant return to scale. Then we find an optimal investment maximizing the value of firm in (A.1) subject to (A.4). The optimal investment is analytically given by

$$\left(\frac{I}{K} \right)_{i,t} = a + \frac{1}{g} \frac{p_t^k}{p_t} \left[\frac{V_{i,t}}{p^k (1-\delta) K_{i,t-1}} - 1 \right] = a + \frac{1}{g} \frac{p_t^k}{p_t} q_{i,t}, \tag{A.5}$$

where $q_{i,t}$ is known as an average q or Tobin's q.

Firm value is the key determinant of investment decision in this basic q model. But given the mismeasurement problem of the average q and the nature of our unlisted firms' data, we need to construct alternative measurements of firm value in our study. Following Foster et al.

(2008), we assume a simplified net revenue function as

$$\Pi_{i,t} = \frac{1}{4\gamma}\left(\phi_{i,t} - \phi^*_{i,t}\right)^2. \tag{A.6}$$

The γ denotes the substitutability of varieties and is assumed to be nonnegative. The $\phi_{i,t}$ and $\phi^*_{i,t}$ denote the profitability index and its threshold respectively. Note that firms start to produce when $\phi_{i,t} > \phi^*_{i,t}$ in this net revenue function.

The profitability index has the form of

$$\phi_{i,t} = \theta_{i,t} - \frac{w_{i,t}}{\omega_{i,t}}. \tag{A.7}$$

The $\theta_{i,t}$ denotes a taste shifter, which has the same meaning as a demand shifter, and firm's profit is positively determined by the demand shifter, i.e.

$$\frac{\partial \Pi_{i,t}}{\partial \theta_{i,t}} = \left(\frac{\partial \Pi_{i,t}}{\partial \phi_{i,t}}\right)\left(\frac{\partial \phi_{i,t}}{\partial \theta_{i,t}}\right) = \frac{1}{2\gamma}\left(\phi_{i,t} - \phi^*_{i,t}\right) > 0. \tag{A.8}$$

The $\omega_{i,t}$ and $w_{i,t}$ represent firm's productivity and input price for production; thereby $w_{i,t}/\omega_{i,t}$ is the marginal cost of production. Thus firm's profit is positively determined by $\omega_{i,t}$ and negatively by $w_{i,t}$, i.e.

$$\frac{\partial \Pi_{i,t}}{\partial \omega_{i,t}} = \left(\frac{\partial \Pi_{i,t}}{\partial \phi_{i,t}}\right)\left(\frac{\partial \phi_{i,t}}{\partial \omega_{i,t}}\right) = \frac{1}{2\gamma}\left(\phi_{i,t} - \phi^*_{i,t}\right)\frac{w_{i,t}}{\omega^2_{i,t}} > 0 \tag{A.9}$$

$$\frac{\partial \Pi_{i,t}}{\partial w_{i,t}} = \left(\frac{\partial \Pi_{i,t}}{\partial \phi_{i,t}}\right)\left(\frac{\partial \phi_{i,t}}{\partial w_{i,t}}\right) = -\frac{1}{2\gamma}\left(\phi_{i,t} - \phi^*_{i,t}\right)\frac{1}{\omega_{i,t}} < 0. \tag{A.10}$$

Therefore, the value of firm in (A.1) has the form of

$$V_{i,t} = \mathbb{E}\left[\sum_{s=0}^{\infty}\frac{\beta^s}{4\gamma}\left(\phi_{i,t+s} - \phi^*_{i,t+s}\right)^2\right]. \tag{A.11}$$

It is positively determined by the demand shifter (demand-side) and the productivity (supply-side) , i.e.

$$\frac{\partial V_{i,t}}{\partial \theta_{i,t+s}} = \left(\frac{\partial V_{i,t}}{\partial \phi_{i,t+s}}\right)\left(\frac{\partial \phi_{i,t+s}}{\partial \theta_{i,t+s}}\right) = \frac{\beta^s}{2\gamma}\mathbb{E}\left[\phi_{i,t+s} - \phi^*_{i,t+s}\right] > 0, \tag{A.12}$$

$$\frac{\partial V_{i,t}}{\partial \omega_{i,t+s}} = \left(\frac{\partial V_{i,t}}{\partial \phi_{i,t+s}}\right)\left(\frac{\partial \phi_{i,t+s}}{\partial \omega_{i,t+s}}\right) = \frac{\beta^s}{2\gamma}\mathbb{E}\left[\left(\phi_{i,t+s} - \phi^*_{i,t+s}\right)\frac{w_{i,t+s}}{\omega^2_{i,t+s}}\right] > 0. \tag{A.13}$$

In brief, the basic q model formulates that firm value is the key determinant of investment decision and Foster et al. (2008) demonstrate that firm value is determined by both the demand shifter and productivity. We thus follow this line of thinking and measure the investment opportunities from the demand side and supply side respectively.

Appendix B Dataset Information

Table B1: Distribution of firm numbers by ownership

year	SOE	Private	Foreign	Collective	Mixed	Total
1998	23,167	39,260	12,344	18,055	5,384	98,210
1999	22,342	38,465	11,787	17,444	5,321	95,359
2000	22,517	38,339	11,920	17,648	5,311	95,735
2001	19,887	45,553	15,076	16,204	6,450	103,170
2002	18,788	65,277	17,825	16,443	6,166	124,499
2003	15,499	76,122	19,992	14,146	6,137	131,896
2004	11,245	79,092	21,743	9,786	4,606	126,472
2005	11,052	142,459	33,210	11,899	6,419	205,039
2006	9,846	156,421	35,076	11,223	6,072	218,638
2007	7,373	181,281	37,781	10,819	6,792	244,046
Total	161,716	862,269	216,754	143,667	58,658	1,443,064

Table B2: Distribution of observations by ownership (%)

year	SOE	Private	Foreign	Collective	Mixed	Total
1998	23.589	39.976	12.569	18.384	5.482	100.000
1999	23.429	40.337	12.361	18.293	5.580	100.000
2000	23.520	40.047	12.451	18.434	5.548	100.000
2001	19.276	44.153	14.613	15.706	6.252	100.000
2002	15.091	52.432	14.317	13.207	4.953	100.000
2003	11.751	57.714	15.157	10.725	4.653	100.000
2004	8.891	62.537	17.192	7.738	3.642	100.000
2005	5.390	69.479	16.197	5.803	3.131	100.000
2006	4.503	71.543	16.043	5.133	2.777	100.000
2007	3.021	74.281	15.481	4.433	2.783	100.000
Average	11.206	59.753	15.020	9.956	4.065	100.000

Notes: All numbers are in percentage terms.

Table B3: Data structure (the age distribution of firms in the dataset)

Number of obs. per firm	Observations	Number of Firms
1	82,183	82,183
2	119,860	59,930
3	302,040	100,680
4	160,436	40,109
5	150,895	30,179
6	172,614	28,769
7	107,772	15,396
8	54,088	6,761
9	66,186	7,354
10	226,990	22,699
total	1,443,064	394,060

Appendix C Definitions of key variables

Tangible fixed assets (K): total fixed assets minus intangible assets

Fixed investment (I): difference between the book value of tangible fixed assets

Cash flow (CF): the sum of firm's net profit and the accumulative depreciation of fixed assets

$q^S(LP)$: supply-side investment opportunities as measured by TFP growth, which is the log difference of TFP and the TFP is constructed using the Levinsohn and Petrin (2003) approach

$q^S(WLP)$: supply-side investment opportunities as measured by TFP growth, which is the log difference of TFP and the TFP is constructed using the Wooldridge (2009) approach

$q^S(ACF)$: supply-side investment opportunities as measured by TFP growth, which is the log difference of TFP and the TFP is constructed using the Ackerberg et al. (2015) approach

$q^S(GMM)$: supply-side investment opportunities as measured by TFP growth, which is the log difference of TFP and the TFP is constructed using the GMM approach

$q^D(sales\ growth)$: demand-side investment opportunities as measured by the sales growth, which is the log difference between current real sales and lagged real sales

$q^D(Excess\ sales\ growth)$: demand-side investment opportunities as measured by the excess sales growth, which is the sales growth minus the mean value of industry-level sales growth

$q^D(Net\ demand\ shock)$: demand-side investment opportunities as measured by the net demand shock, which is a residual term by isolating factors other than demand (such as firm size, productivity) from the sales growth

$q^D(Inventory\ growth)$: demand-side investment opportunities as measured by the inventory growth, which is the first difference of inventory stock scaled by tangible fixed capital

q^F: investment opportunities measured from future profitability, i.e. the fundamental q

Tangibility: the ratio of tangible fixed assets to total assets

Liquidity: the ratio of liquid assets to tangible fixed assets

Size: the natural logarithm of the real total assets

Age: the natural logarithm of the number of years since the firm is established

Expdum: an export dummy equal to one if the firm exports in that year, and zero otherwise

FMDI: financial market development index. We sort the index form high to low over our sample years and use the median value to divide the provinces into two groups. The provinces in the 'High' group include: Guangdong, Zhejiang, Shanghai, Jiangsu, Fujian, Beijing, Tianjin, Shandong, Liaoning, Chongqing, Sichuan, Anhui, Hebei, Hubei, Hainan, Henan. The provinces in the 'Low' group include: Hunan, Jiangxi, Jilin, Guangxi, Heilongjiang, Shanxi, Neimenggu, Yunnan, Guizhou, Xizhang, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

SOE: an ownership dummy equal to one if the average share of capital paid-in by state over the period of 1998-2007 is greater than 50%, and zero otherwise

PRIV: an ownership dummy equal to one if the average share of capital paid-in by private investors over the period of 1998-2007 is greater than 50%, and zero otherwise

FOR: an ownership dummy equal to one if the average share of capital paid-in by foreign investors over the period of 1998-2007 is greater than 50%, and zero otherwise

COL: an ownership dummy equal to one if the average share of capital paid-in by collective investors over the period of 1998-2007 is greater than 50%, and zero otherwise

Deflators: the provincial capital goods deflator is used to deflate the capital stock, and the provincial producer price indices (PPI) for manufactured goods is used to deflate other variables. The data is from the China Statistical Yearbook (various issues), published by the National Bureau of Statistics of China.