

# The effect of investment tax incentives: evidence from China's value-added tax reform

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**Abstract** We estimate the impact of investment tax credit on firm fixed investment in a difference-in-differences-in-differences framework, using China's 2004 value-added tax reform pilot that introduces a permanent 17%-tax credit for fixed investment in six industries in the Northeastern region. The tax credit raises significantly fixed investment of eligible firms by 28% on average during 2004–2007 relative to 2001–2003, corresponding to a user cost elasticity of 1.84. The tax incentive has larger effects on firms that are less financially constrained such as smaller firms and firms with a larger cash flow. The result is largely driven by responses of domestic private firms and is robust to specifications addressing the issue of anticipation.

**Keywords** Firm fixed investment · Investment tax credit · Value-added tax reform · China

**JEL Classification** G31 · H25 · H32

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## 1 Introduction

Investment is one of the most important factors determining economic fluctuation in the short run and economic growth in the long run. For this reason, governments in many countries have long been engaged in designing policies to affect business investment, with the investment tax credit a prominent instrument. Empirical findings, however, vary substantially regarding the size and robustness of the impact of taxation on business investment. This paper provides new evidence on the impact of taxation on firm investment expenditure, taking advantage of variations in the tax credit across both regions and industries that are brought about by the 2004 Chinese value-added tax (VAT) reform pilot.

China's VAT was introduced in the 1994 fundamental tax reform. In part to curb the then rapid investment growth and overheating economy, the tax was of production type—firms' purchases of investment goods were not deductible from the value of final products as the VAT base. Over time, there have been increasing concerns over the disincentives to firm investment due to this double taxation. In 2003, the central government decided to permanently convert the VAT to one of consumption type, which allows the deduction of investment expenses. The reform pilot that started in 2004 applied to firms in six broadly defined manufacturing industries located in the three provinces of the Northeastern (NE) region. It was expanded to 26 more cities in central China in 2007 and was implemented nationwide at the beginning of 2009.

Focusing on the 2004 reform pilot, we estimate the effect of the VAT reform on the investment of eligible firms. The 2004 VAT reform pilot is a rare situation for a tax change in which the eligibility is unambiguously defined by time, region, and industry. This allows us to achieve credible identification of the effect of the tax change on eligible firms in a difference-in-differences (DID) framework, where the treatment and control groups are selected based on an exogenous eligibility rule. We employ data from the Annual Survey of Industrial Firms for 2000–2007. We use firms in the ineligible industries in the NE region to control for region-specific trend in investment and all firms outside the NE region to control for industry-specific trend in the absence of the tax reform. We control for firm characteristics that may independently affect firm investment. Once these confounding factors are removed, the extra increase in fixed investment by firms in the eligible industries in the NE region can be attributed to the investment tax credit due to the VAT reform.

Our main findings are the following. First, we show graphically that while the treatment and control groups follow the same investment trend before the reform, their investment behavior diverges sharply after the reform, with the treatment group showing substantial increases in 2005 and 2007. We find in regression analyses that the tax credit raises significantly the fixed investment of eligible firms by 28% on average during 2004–2007 relative to 2001–2003, corresponding to a user cost elasticity of 1.84.

Second, in a series of heterogeneity analyses, we show that firm responses to the investment tax credit are sensitive to internal funds availability. Only firms with large cash flow ratios experience significant increases in investment following the VAT reform. These firms tend to be smaller firms in terms of both employment and capital stock. In addition, while domestic privately owned firms and state-owned enterprises

(SOEs) are almost equally responsive to the investment tax credit, the cash flow ratio of domestic private firms is more than three times as large as that of the SOEs.

This paper is closely related to the large literature that studies the effect of taxes on business investment. Early studies such as [Hall and Jorgenson \(1967\)](#), [Feldstein \(1982\)](#), [Auerbach and Hassett \(1992\)](#), and [Chirinko et al. \(1999\)](#) use time-series variations in tax rates and find significant responses of postwar US business investment to tax changes. This approach, however, cannot disentangle the cost-of-capital effects and the business-cycle effects; for example, temporary investment tax credits that lower the user cost of capital are often introduced during economic downturns when investment is also low. More recent studies use disaggregate data and take advantage of cross-sectional variations in tax treatment of different types of asset that come mostly from differences in depreciation across assets. A depreciation–acceleration provides larger subsidy to long-lived assets than short-lived assets and hence may lead to larger increases in the investment in the former. Due to the lack of investment data disaggregated by asset types, existing studies exploit the variation across firms or industries that use a different mixture of capital inputs ([Auerbach and Hassett 1991](#); [Cummins et al. 1994](#); [Desai and Goolsbee 2004](#); [Cohen and Cummins 2006](#); [House and Shapiro 2008](#); [Edgerton 2010](#) and [Zwick and Mahon 2017](#)). They generally find positive impacts of a tax credit on investment, but the magnitude of their estimates varies widely, reflecting many of the measurement issues associated with this approach.

We contribute to the tax-investment literature in the following fronts. First, taking advantage of a quasi-experiment in tax reform, we identify the impact of taxation on firm investment using a simple and straightforward DID strategy. Indeed, our results can be seen clearly in the raw data and in a simple graph. Our approach links the tax change directly to changes in investment and allows us to circumvent the measurement issues when structural variables (the user cost of capital) are used. Only two other recent papers apply a similar DID approach. Using US data, [Zwick and Mahon \(2017\)](#) find large responses of investment to bonus depreciation; they estimate a user cost elasticity of approximately 1.6; [Yagan \(2015\)](#) considers differential treatments of the C-corporations and S-corporations in dividend taxation and finds that dividend tax cut has no effect on investment.

Second, our results provide evidence of the impact of tax incentives in an alternative institutional environment. All but a few studies focus on tax changes in the USA. [Cummins et al. \(1996\)](#) study empirically the investment effects of tax reforms in 14 OECD countries. [Djankov et al. \(2010\)](#) show in a cross section of 85 countries that effective corporate tax rate has a large adverse effect on aggregate investment. Empirical research on developing countries mostly focuses on exemptions from import duties ([Zee et al. 2002](#)). [Nie et al. \(2009\)](#) and [Cai and Harrison \(2011\)](#) study the same VAT reform pilot as the present paper. The former uses data up to 2005 and finds a positive impact of the VAT reform on the investment of eligible firms; it, however, lacks robustness analyses. The latter uses a subsample of the data we use and finds no effect of the VAT reform on firm investment.<sup>1</sup> We conduct numerous sensitivity analyses to

<sup>1</sup> [Cai and Harrison \(2011\)](#) match firms that are included in the Annual Survey of Industrial Firms in 1998, 2003, and 2007; firms in their analysis sample are likely very large firms. Their finding of a null effect is consistent with our finding that larger firms are virtually not affected by the VAT reform.

demonstrate the robustness of the positive effect of the VAT investment credit. Our heterogeneity analyses provide further insights into how financial constraints may affect firms' ability to take advantage of the tax credit. The finding that domestic private firms respond significantly to the tax incentive suggests that our results have broader implications for policy making in countries at similar development stages.

The paper proceeds as follows. In the next section, we briefly describe the institutional background of enterprise reform in China and provide details of the evolution of the VAT, in particular, events surrounding the VAT reform in 2004. Section 3 discusses the empirical strategy. Section 4 describes the data and provides graphical evidence of the impact of the 2004 VAT reform on the investment of eligible firms. Section 5 presents estimates of this impact from the regression analysis and robustness checks. Section 6 concludes.

## 2 Background

### 2.1 Evolution of China's industrial firms

In the centrally planned economy prior to the economic reforms starting in 1978, all Chinese industrial firms were state-owned enterprises (SOEs). Firms produced following a central plan, sold products at prices set by the government, submitted all surpluses to, and received investment funds from their respective administering government agencies. Firms, on behalf of the government, were also responsible for providing social services to their employees such as pension and health care. Pursuing profits was not their main objective (Bai et al. 2006). SOE reforms in the early 1980s focused on "delegating decision-making power and providing incentives" and continued in the 1990s and 2000s with the goal of establishing modern corporate governance. During the process, many small- and medium-sized SOEs were privatized or shut down, while non-state firms experienced rapid growth and became increasingly more important in the economy. Yet, since the SOEs that remain tend to be larger firms deemed of strategic importance, they continue to receive favorable treatment from the government such as better access to bank loans or funds directly from the state budget (Cai and Liu 2009; Wu 2010).

As firms became more responsive to market incentives, fiscal relationships with the government also changed. The 1994 fundamental tax reform created the current tax system. The most important taxes on manufacturing firms are the value-added tax (VAT, more details below) and corporate income tax. All but very small domestic firms pay 33% corporate income tax, and foreign-owned firms pay a reduced rate of 15%. In 2008, the corporate tax rate was unified to 25% regardless of ownership. On the spending side, the 1990s and 2000s witnessed the central government's continued effort to establish a comprehensive social security system to relieve firms of social responsibilities.

The SOE reform, however, did not proceed in the same pace nationwide, with the Northeastern region (Heilongjiang, Jilin, and Liaoning provinces, combined to account for 10% of China's GDP in 2003) lagging behind, mostly for the sheer magnitude of its state sector and the social turmoil a hasty transition may cause. To speed up the

transition of the “old” industrial firms in this region and to facilitate their adoption of new technologies, in October 2003 the central government decided to implement a package of preferential policies, including exemption of tax arrears, investment tax credits, and fiscal assistance to laid-off workers and retirees.<sup>2</sup> While the package is aimed at SOEs, it applies to all firms in the region, regardless of ownership or industry, and the policies are implemented gradually over the coming years. The investment tax credit brought about by the VAT reform is one of the preferential policies, but it differs from all other policies in that it applies to a subset of industries, as described in more detail below.

## 2.2 Value-added taxation in China

A value-added tax (VAT) is a tax on firms on the difference between total values of sales and purchases of inputs from other firms. Purchases of capital goods are usually counted as inputs, rendering VAT a consumption tax. The most common way of administering a VAT is to levy a tax on the total value of sales at each stage of production and allow a credit for any VAT paid on inputs in production. Due to its low administration cost and small economic distortion, VAT is adopted by more than 130 countries and raises more than 20% of tax revenue.

China adopted the VAT nationwide in all industrial sectors in the 1994 fundamental tax reform with a standard rate of 17%, a reduced rate of 13%, and a zero rate for exports. It has since been the most important source of government tax revenue. From 2001 to 2008, taxation on domestic value-added accounts for, on average, 36% of total tax revenue.

The VAT adopted in 1994 differs from the traditional consumption-type VAT in one important respect: Purchases of fixed investment are not deducted from the sales of final product in calculating a firm’s VAT liability. In other words, investment goods are twice subject to the VAT, first as final products of their producers and second as intermediate inputs of their users. For users of the investment goods, this represents a 17-percentage point increase in the acquisition price. This design was adopted to preserve government tax revenue and to restrain firm investment in a then overheating economy. With the steady growth in tax revenue, the concern over its investment disincentives became dominant, and policy makers started to plan the gradual repeal of this double taxation on fixed investment.

## 2.3 VAT reform since 2004

The proposal to overhaul the VAT was put forward in October of 2003 as one of the government’s top priorities to improve the functioning of the free market.<sup>3</sup> In the same

<sup>2</sup> “Advocates of the Chinese Communist Party Central Committee and State Council for the Implementation of Strategies to Revitalize the Old Industrial Base of the Northeastern Region,” October 5, 2003. It consists of programs targeted at all aspects of the economy, including agricultural sector, service sector, international trade, education, and social security.

<sup>3</sup> “Decision of the Chinese Communist Party Central Committee on Issues on Perfecting the Socialist Market Economic System,” October 14, 2003.

month, in the package of preferential policies to revitalize the lagging NE economy, it was stated for the first time that conversion of the VAT to a consumption type would be firstly implemented in six broadly defined industries of the manufacturing sector in the three Northeastern provinces. Public debates and policy deliberations continued well into 2004.

In September of 2004, a decree was issued that the VAT reform would start in six industries of the manufacturing sector in the Northeastern provinces, retroactive to July 1, 2004.<sup>4</sup> For these industries, all the cost (including some labor cost) related to the purchase, transportation, and installation of fixed investment in equipment can be deducted from the sales of the final product in calculating a firm's VAT liability.<sup>5</sup> To prevent a steep drop in tax revenue, however, eligible firms are restricted to claim a VAT credit no more than the *increment* in their VAT liability over the previous year and to carry forward the remaining credits to future years. Policy makers expected this reform pilot to stimulate the fixed investment and the adoption of new technologies by eligible firms in the NE region.

In May of 2007, it was announced that starting July 1, 2007, the VAT reform would be expanded to 26 industrial cities in six provinces of central China where the mining, electricity, and utility sectors would also be eligible. Finally, on January 1, 2009, the VAT reform was implemented nationwide in all industries of the mining, manufacturing, and electricity and utility sectors as a stimulus against the backdrop of the global economic crisis.<sup>6</sup> At this final stage of reform, firms are allowed to claim VAT credits on purchases of fixed investment up to the amount of current VAT liability and carry forward any remaining credits.

To summarize, China's VAT reform since 2004 represents a permanent reduction in the cost of fixed investment, initially for firms in eligible industries and regions and eventually for all industrial firms. At a rate of 17%, this cost reduction may have a substantial impact on business investment. Our empirical analysis focuses on the first stage of the VAT reform that was carried out in the three NE provinces from 2004 to 2007. Given the eligibility requirements in both region and industry, we conduct the analysis in a difference-in-differences-in-differences (DDD) framework. This research design allows us to achieve a credible estimate of the effect of a tax policy change on business investment.

<sup>4</sup> “Decision of the Ministry of Finance and the State Administration of Taxation on Issues on the Expansion of Deduction of the Value-Added Taxation in the Northeastern Provinces,” September 14, 2004. The six broadly defined industries are: (1) machine and equipment manufacturing, (2) automobile manufacturing, (3) petroleum, chemical, and pharmaceutical manufacturing, (4) ferrous and nonferrous metallurgy, (5) agricultural product processing, and (6) ship building.

<sup>5</sup> Investment in structures is not deductible under this reform pilot or the nationwide reform. Labor cost associated with transportation and installation is deductible only if these services are directly provided by the firms that sell fixed investment goods.

<sup>6</sup> “Decision of the Ministry of Finance and the State Administration of Taxation on the Nationwide Implementation of the Value-Added Taxation Reform,” December 19, 2008.

### 3 Analytical framework

In the simple neoclassical model of investment (Jorgenson 1963), a value-maximizing firm chooses its capital stock so that the marginal product of capital equals a shadow rental price of capital,  $c$ , commonly referred to as the user cost of capital.<sup>7</sup> Following Auerbach and Hassett (1991),

$$c = q(1 - \Gamma)[r + \delta - \dot{q}/q]/(1 - \tau), \quad (1)$$

where  $q$  is the relative price of investment goods in terms of output,  $r$  is the real interest rate,  $\delta$  is the rate of economic depreciation of investment goods,  $\tau$  is the corporate tax rate, and  $\Gamma$  is the present value of tax savings from depreciation and other investment incentives such as investment tax credit,

$$1 - \Gamma = (1 - k)(1 - \tau d). \quad (2)$$

In Eq. (2),  $k$  is the investment tax credit, and  $d$  is the present value of the depreciation deduction rate on investment. A change in  $\Gamma$  changes the user cost of capital and hence the optimal capital stock and investment through its impact on  $q(1 - \Gamma)$ , the effective relative price of investment goods taking into account investment-related taxation. *Ceteris paribus*, an increase in  $\Gamma$  shifts the demand for investment goods outward; to the extent that the supply of investment goods is not perfectly inelastic, this change leads to an increase in the equilibrium quantity of fixed investment.<sup>8</sup> The magnitude and dynamics of the impact are inherently an empirical question and crucially depend on whether the tax change is permanent or temporary, anticipated or unanticipated, and financial constraints firms may face.

China's 2004 VAT reform pilot essentially increases  $k$  for eligible firms from  $-17\%$  to  $0$  while maintaining the low rate of  $-17\%$  for the rest of the industrial firms during 2004–2007. It generated variations in the tax regime in three dimensions: (1) years before and after the reform, (2) eligible and ineligible industries within the reform region, and (3) reform and non-reform regions. These variations provide a rare opportunity for estimating the causal relationship between investment tax credit and fixed investment in a straightforward DID framework.

First, we compare the change in investment of firms in the eligible industries and ineligible industries within the NE region before and after 2004. This is a standard DID analysis, where we use the investment trend of firms in the ineligible industries in the NE region to account for region-specific macroeconomic trends and policy changes that may affect all firms in the NE region. Two policy changes introduced in July 2004 may affect investment behavior of all industrial firms in the NE region: (1) Firms are allowed to raise the depreciation rate of fixed assets by up to 40%; (2)

<sup>7</sup> Empirical studies typically assume convex cost of adjusting the capital stock, the idea being that it is more costly to implement a given increment to the capital stock quickly rather than gradually. Since the conceptual discussion here is for illustration only, we abstract from this complication.

<sup>8</sup> Goolsbee (1998) discusses how responses of the supply of investment may attenuate the impact of investment tax incentive. House and Shapiro (2008) also emphasize the supply-side response. We essentially estimate the impact of tax credit on the equilibrium quantity of fixed investment.

salary deductible from corporate tax base increases from 800 Yuan to 1200 Yuan per employee in all firms. The former may stimulate fixed investment, while the latter by changing the relative price of labor to investment may discourage investment. Furthermore, in December 2006 the central government initiated an effort to exempt all tax arrears accumulated before December 31, 1997, for virtually all NE firms, which are estimated to be 10 Billion Yuan, about 7% of the tax revenue of the NE provinces in 2007.<sup>9</sup> It requires local tax authorities to complete the application and approval process by March 31, 2007. This, by reducing the effective corporate tax rate, may provide NE firms a strong incentive to invest in 2007.

Second, we compare the change in investment of firms in the eligible and ineligible industries outside the NE region before and after 2004. This DID analysis removes the investment trend specific to the non-NE region, and the remaining difference captures the investment trend specific to eligible industries that is due to changes other than the VAT reform. Finally, we take the difference between the two differences from the first two steps. This removes the investment trend specific to the eligible industries in general, and the remaining difference reflects the extra investment of firms in the NE region eligible for the VAT reform—hence the effect of the tax incentive on eligible firms.

We implement the DDD analysis in the following regression equation:

$$\text{rgfinv}_{ijrt} = \alpha_i + \alpha_{jt} + \alpha_{rt} + \beta \cdot \text{NE}_{ir} \cdot \text{Aft}_{it} \cdot \text{EInd}_{ij} + \gamma \cdot X_{ijrt} + \varepsilon_{ijrt}, \quad (3)$$

where  $\text{rgfinv}_{ijrt}$  measures investment of firm  $i$  in industry  $j$ , region  $r$ , and year  $t$ .  $\alpha_i$  is firm fixed effects to capture baseline investment.  $\alpha_{jt}$  and  $\alpha_{rt}$  are year-region and year-industry fixed effects that allow for different time trends by industry and region such as that due to industry-specific technological progress and preferential policies implemented in the NE region after 2003. Region- and industry-specific demand-side factors are also captured by these interactions. We control for a vector of firm-specific control variables ( $X_{ijrt}$ ) including firm ownership, cash flow, profitability, and capital intensity. The state-owned and private firms may face different internal and external constraints that may lead to different investment patterns. Cash flow is controlled to explore the potential importance of financial constraint in determining investment (Hubbard 1998). Aft equals 1 for the 2004–2007 period and 0 for 2001–2003 period; NE equals 1 for the NE region and 0 otherwise, and EInd equals 1 if a firm belongs to one of the six eligible industries and 0 otherwise. The coefficient on the interaction of time, region, and industry indicators,  $\beta$ , measures the average effect of the tax credit on fixed investment of eligible firms, after other confounding factors are removed.

In a robustness check, we estimate the investment dynamics of eligible firms in a model with interactions of region, industry, and a full set of year dummies. This allows us to address two concerns. First, the pre-reform investment trend indicates whether the eligible firms would follow the same relative investment growth path as the ineligible firms absent the tax credit. Verifying this is of particular importance in

<sup>9</sup> “Guideline of the Ministry of Finance and the State Administration of Taxation on the Exemption of Tax Arrears of Firms in the Northeastern Provinces,” December 6, 2006. See [http://chinaneast.xinhuanet.com/2007-01/09/content\\_8994116.htm](http://chinaneast.xinhuanet.com/2007-01/09/content_8994116.htm).

our context since the eligible firms are not a random subset of all firms. Second, in Eq. (3), we take 2003 as the last year before and 2004 as the first year after the VAT reform for eligible firms. It may well be that expecting the policy change in the near future eligible firms temporarily postpone their 2003 fixed investment; this could lead to an overestimate of the policy effect. Uncertainty about the exact timing of reform may also cause the eligible firms to be unable to carry out their investment in the last quarter of 2004 shortly after the reform is announced.

In Eq. (3), we also assume that firms ineligible for the 2004 reform expect the prevailing VAT regime to last indefinitely. If, however, some ineligible firms postpone their investment because they expect the expansion to materialize soon, we may overestimate the impact of the reform. Given the past experience of China's economic reform, where a policy change usually starts as a small-scale experiment and gradually expands to the entire nation but with great uncertainty in the pace of the expansion (Wu 2010), it is plausible that ineligible firms are unable to predict the timing of the VAT reform expansion and hence make investment decisions based on the current regime. Nevertheless, we conduct robustness checks to further explore this issue in Sect. 5.

Financial constraint may be a particularly important factor affecting Chinese firms' responses to investment tax credits. Due to the underdevelopment of the banking sector and the financial market in general, firms tend to rely heavily on internal funds, especially domestic private firms (Allen et al. 2005; Guariglia et al. 2011). In Sect. 6, we conduct a series of analyses using subsamples of firms to directly investigate how firm responses to the investment tax credit may be constrained by internal funds availability.

## 4 Data

### 4.1 Data set

The primary data source is the Annual Survey of Industrial Firms (ASIF) maintained by the National Bureau of Statistics of China (NBS); we use data from 2000 to 2007. The data include all the state-owned enterprises (SOEs) and non-SOEs with annual sales over 5 million Yuan ("above scale"), about 600,000 US dollars during the sample period, in the mining, manufacturing, and electricity and utility sectors. In 2007, these firms contribute to 47.4% of China's industrial value added, and their employment accounts for 26.8% of overall urban employment. The surveys contain basic information about firm characteristics and many of the financial variables from the balance sheet, income statement, and cash flow statement. All variables are measured at the end of a calendar year.

We take the following steps to create a clean sample and to reduce the influences of extreme values. (1) We exclude firms in the mining, electricity, and utility sectors; thus, our sample includes only firms in the 30 two-digit industries of the manufacturing sector. We also exclude firms located in the 26 cities of central China, where the VAT reform expands to in 2007. (2) We exclude observations with zero or negative measures of sales, outputs, asset stock, employment, wages, intermediate inputs, and total paid-in capital. (3) We exclude observations that take negative values in any one of the

following: total asset minus liquid asset, total asset minus net fixed asset, accumulated depreciation minus current-year depreciation, and total paid-in capital minus paid-in capital from each type of investor. (4) We further exclude observations with fewer than 20 employees; this is likely misreporting given that the firms in our sample are generally quite large. (5) Finally, we restrict our sample to observations with at least 100,000 Yuan in net fixed asset stock to remove artificially large values of fixed investment rate due to a small base. From these procedures, we obtain a sample of 1,026,624 observations representing 326,252 unique firms. To reduce the influence of outliers, we winsorize fixed investment rate at the top and bottom 0.5th percentile of its distribution for each year–province combination.<sup>10</sup>

## 4.2 Variable definition

Following the literature, we use investment rate, defined as the ratio between current-year gross fixed investment (GFI) and beginning-of-year net fixed asset stock (NFAS), as our dependent variable ( $\text{rgfinv}$ ). This normalization allows us to compare firms of a wide range of scales.

$$\text{rgfinv}_t = (\text{GFI}_t / \text{FIFI}_t) / (\text{NFAS}_{t-1} / \text{FIFI}_{t-1}) * 100, \quad (4)$$

where FIFI is the price index of fixed investment relative to year 2000, obtained from the 2009 Statistic Yearbook of China.

Two clarifications are in order. First, because the data do not include a measure of the current-year GFI, it is backed out as the difference between current-year gross fixed asset stock (*GFAS*) and the previous year *GFAS*. In firm original accounting statement, each year's fixed investment is entered at the current price at the time of acquisition, and GFAS is simply the sum of the values of all fixed assets still in use measured at their respective acquisition prices. Thus, the backed-out GFI is in current price, and we convert it to a constant price measure using FIFI. Second, NFAS in Eq. (4) is the sum of net asset values measured at various acquisition prices. To convert it to a constant price series, many authors use the perpetual inventory method to reconstruct the entire series of fixed investment and depreciation (Salinger and Summers 1983), making assumptions about investment growth rates and depreciation rates. This adjustment is particularly important in times of high inflation; otherwise, NFAS would greatly overestimate the value of more recent investment relative to earlier investment. We directly divide NFAS by current-year FIFI, assuming current-year FIFI is a good proxy for FIFI of past years when fixed investment was made. We believe this is a sound simplification as the fixed investment prices have been quite stable since 1990, the first year the series was published, as depicted in Appendix Fig. 2.

<sup>10</sup> For robustness checks, we conduct DDD estimates for alternative samples, including a sample that drops observations in the top and bottom 0.5% of the investment rate distribution, one that winsorizes investment rate at top and bottom first percentile, one that drops firms with less than 200,000 Yuan in net fixed asset stock, one that also restricts firms in sales, and a few other cases. While the point estimate varies somewhat, the elasticity measures are in a tight range between 1.65 and 2.13.

We create the indicator for whether an industry is eligible for the 2004 VAT reform based on the detailed guideline of the Ministry of Finance and State Administration of Taxation.<sup>11</sup> For all but two 2-digit industries in the manufacturing sector, all firms in an industry are either eligible or ineligible. For the remaining two industries, the classification is along the line of 3-digit industry code. This inclusiveness in classification makes it difficult for firms to switch industries to take advantage of the tax incentive, ensuring that the same firm is eligible (or ineligible) both before and after the reform.<sup>12</sup> Table 1 lists the 2-digit (3-digit) industries by eligibility and broad category.<sup>13</sup> Eligible industries account for roughly 80% of the sample firms (83 and 80% in and outside of the NE region) and 85% of total sales (92 and 85% in and outside the NE region). The ineligible industries include primarily tobacco, metal and nonmetal mineral products industries, which the central government does not wish to subsidize.

Following [Dollar and Wei \(2007\)](#) and [Guariglia et al. \(2011\)](#), we define firm ownership based on the fraction of paid-in capital contributed by different types of investors.<sup>14</sup> A firm is state (domestic privately or foreign) owned if the paid-in capital contributed by state (domestic private sector or foreign sector) accounts for more than 50% of its total capital or the largest share of its total capital when none of the three types of investors have a dominant share. Foreign investors include those from Hong Kong, Macao, Taiwan, and all foreign countries. One type of investor in the data is “legal persons,” or corporations, a mixture of state legal persons and private legal persons, which are not separately classified. We define investment by “legal persons” as domestic private investment due to lack of more precise information; incentives provided by legal-person ownership are likely closer to that of private ownership than direct state ownership ([Cull and Xu 2005](#)).

Control variables are created as follows. Cash flow equals pre-tax profit plus current-year depreciation, normalized by net fixed asset stock. Two other factors we control for are firms’ capital profitability, defined as the ratio between pre-tax profit and total

<sup>11</sup> Industry code is filled in by local statistic bureau based on a firm’s primary product. Chinese government revised the industry code in 2003 by splitting one 4-digit industry into multiple 4-digit industries, merging multiple 4-digit industries into a new, single 4-digit industry, or changing a 4-digit code to a different one. Many of these changes may switch a firm from one 2-digit or 3-digit industry to another. As the eligibility for the VAT reform experiment is based on the industry classification in 2004, we adjust all firm industry codes to their new 2003 values.

<sup>12</sup> Over the sample period, 15,257 firms (66,487 observations) changed between eligible and ineligible industries. Changes are in both directions and occur both in and outside the NE region; slightly more changes occurred in 2003 and 2004 than in other years. Our regression results are robust to using the sample of firms that never changed industries.

<sup>13</sup> In the 2004 Decision referred to in Footnote 4, firms in the high-tech industry are also eligible for the VAT reform. However, to be classified as in the high-tech industry, a firm had to submit an application to and get the approval from the Ministry of Finance and the State Administration of Taxation. The decision to apply is likely endogenous to investment decisions. We therefore classify approved high-tech firms as ineligible, which may lead to underestimation of the tax effect. Nevertheless, there are only a total of 164 firms in this category, negligible relative to the large sample size. Additionally, many of these belong to the six eligible industries.

<sup>14</sup> Survey of firms by [Dollar and Wei \(2007\)](#) indicates that the ownership type on a firm’s registration form is not entirely reliable as it is updated with considerable delays following changes in actual capital sources. Our results are robust to using ownership code on the registration form.

**Table 1** 2-Digit (3-digit) manufacturing industries and eligibility for 2004 VAT reform pilot in the North-eastern (NE) region

2-Digit (3-digit) industries	VAT reform eligibility in 2004
[13] Agricultural and by-product processing	5
[14] Food production	5
[15] Beverage production	5
[16] Tobacco products processing	7
[17] Textile	5
[18] Garments manufacture	5
[19] Leather, furs, down and related products	5
[20] Timber processing, bamboo, and straw products	5
[21] Furniture manufacturing	5
[22] Paper making and paper products	5
[23] Printing and record medium reproduction	7
[24] Cultural, education, sports article production	7
[25] Petroleum, coking, and nuclear fuel processing	
[251] Refined petroleum products	3
[252] Coking	7
[253] Nuclear fuel processing	3
[26] Raw chemical materials and chemical products	3
[27] Medical and pharmaceutical products	3
[28] Chemical fibers	3
[29] Rubber products	3
[30] Plastic products	3
[31] Nonmetal mineral products	7
[32] Smelting and pressing of ferrous metals	4
[33] Smelting and pressing of nonferrous metals	4
[34] Metal products	7
[35] Ordinary machinery manufacturing	1
[36] Special equipment manufacturing	1
[37] Transportation equipment manufacturing	
[371] Railway transport equipment manufacturing	1
[372] Automobile manufacturing	2
[373] Motorcycle manufacturing	7
[374] Bicycle manufacturing	7
[375] Ships and floating equipment manufacturing	6
[376] Aerospace and aeronautic equipment manufacturing	1
[378] Transportation equipment repairing	7
[379] Other transportation equipment manufacturing	1
[39] Electric machines and apparatuses manufacturing	1
[40] Computer and communication equipment manufacturing	1

**Table 1** continued

2-Digit (3-digit) industries	VAT reform eligibility in 2004
[41] Instruments, cultural and office machinery manufacturing	1
[42] Crafts work and other manufacturing	5
[43] Waste recycling and processing	7

The six broadly defined eligible industries are: (1) machine and equipment manufacturing, (2) automobile manufacturing, (3) petroleum, chemical, and pharmaceutical manufacturing, (4) ferrous and nonferrous metallurgy, (5) agricultural product processing, and (6) ship building. (7) indicates the ineligible industries

asset, and firms' capital intensity, defined as the ratio between employment and net fixed asset stock. We expect both to have a positive effect on investment rate.

### 4.3 Firm characteristics

Panel A of Table 2 reports the composition over time overall and by firm ownership for the entire sample and for the samples of firms in and outside the Northeastern region (NE) separately. Overall, the number of firms increases continuously over time as the 5 million Yuan criterion becomes easier to meet due to the rapid expansion of the Chinese economy. Because we calculate fixed investment as the difference in net fixed asset stock between two consecutive years, the number of sample firms in each year is largely restricted by the number in the previous year. The sharp increase in the firm number in 2005 thus reflects the fact that the more comprehensive Industrial Census in 2004 identifies a large number of firms that were left out of the annual survey due to imperfect business registry.<sup>15</sup> The growth of the number of firms is primarily driven by the expansion of the domestic private sector, whereas the state sector shrinks. Most of the "new" firms are not newly created firms but instead are existing firms that grow and become eligible for inclusion in the sample. Firms exit the data set when they shrink, go bankrupt, or are acquired by other firms. There are substantial differences in the composition of firms between the NE and non-NE regions. While the share of SOEs in the NE region in 2001 (33%) is significantly higher than other regions (19%), it also decreases more rapidly over the sample period, reflecting an acceleration of SOE reforms in the NE region; by 2007, the share of SOEs in and outside the NE region is quite close, at 4 and 2.5%, respectively. Correspondingly, the domestic private sector experiences a faster growth in the NE region than the rest of the country. The share of the foreign-owned firms remains stable in both regions, but it is significantly smaller in the NE region (11%) than in other regions (17%).

Panel B of Table 2 reports the average value of several important firm characteristics over time for the entire sample and for NE firms only. Since the NE firms account for less than 6% of the sample, the characteristics of the entire sample reflect very closely those of the non-NE firms. On average, firms become smaller, measured in

<sup>15</sup> This is discussed in Lu and Tao (2009) and Brandt et al. (2012). They report similar trend in the number of firms, with a sharp increase in 2004. In our sample, this shows up in 2005.

**Table 2** Firm characteristics (end of previous year values)

Year	All				Northeastern (NE) region				Non-NE regions			
	Total	% SOE	% Domestic	% FDI	Total	% SOE	% Domestic	% FDI	Total	% SOE	% Domestic	% FDI
		% private			% private		% private		% private		% private	
A. Number of industrial firms and distribution by ownership												
2001	83,925	18.38	64.53	17.09	4423	32.69	56.39	10.92	79,502	17.59	64.98	17.43
2002	107,497	13.68	70.34	15.98	6162	25.84	64.25	9.92	101,335	12.95	70.71	16.35
2003	116,247	10.52	72.89	16.59	6503	18.78	70.35	10.87	109,744	10.03	73.05	16.92
2004	115,502	7.55	73.68	18.76	6902	15.33	72.37	12.3	108,600	7.06	73.77	19.17
2005	183,411	4.56	77.47	17.97	9988	9.06	79.69	11.25	173,423	4.3	77.35	18.36
2006	198,197	3.58	78.61	17.81	11,895	6.12	82.77	11.11	186,302	3.42	78.35	18.24
2007	221,825	2.45	80.22	17.33	14,530	3.97	85.22	10.81	207,295	2.35	79.87	17.79
Total	1,026,604	7.01	75.53	17.45	60,403	12.46	76.5	11.04	966,201	6.67	75.47	17.85

**Table 2** continued

All Firms						NE firms							
	Employment	Net fixed asset stock (NFAS)	Sales 1,000 Yuan	Capital intensity (emp/NFAS) 1,000 Yuan	Capital profitability (profit/total asset)	Cash flow ratio (CF/ NFAS)	Employment	Net fixed asset stock (NFAS)	Sales 1,000 Yuan	Capital intensity (emp/ NFAS) 1,000 Yuan	Capital profitability (profit/ total asset)	Cash flow ratio (CF/NFAS)	
B. Summary statistics of main firm characteristics													
2001	346.8	29876.8	59493.1	0.061	0.047	0.324	523.1	54885.1	66377.4	0.065	0.030	0.260	
2002	314.3	29254.5	65689.3	0.064	0.056	0.370	451.7	55899.8	80911.2	0.058	0.036	0.253	
2003	306.1	29584.8	70564.4	0.064	0.060	0.407	419.6	55230.7	88715.1	0.057	0.034	0.267	
2004	297.9	29096.9	79918.8	0.061	0.063	0.450	352.8	42781.2	87525.1	0.053	0.037	0.305	
2005	243.8	23869.1	77653.8	0.064	0.069	0.471	254.4	32251.7	74009.1	0.050	0.044	0.374	
2006	251.6	28863.9	109657.2	0.055	0.084	0.541	253.9	38257.0	96899.4	0.042	0.053	0.370	
2007	242.3	29080.3	127715.1	0.052	0.094	0.590	226.7	36931.5	151829.1	0.040	0.062	0.417	
Average	273.9	28249.9	91364.1	0.059	0.072	0.478	316.5	42233.5	104081.1	0.049	0.046	0.343	

Sample excludes firms in the 26 cities in Central China where the VAT reform starts in the second half of 2007. Northeastern (NE) region includes Heilongjiang, Jilin, and Liaoning provinces. All firm variables are measured at the beginning of year (end of previous year). Net fixed asset stock (NFAS) is adjusted by fixed investment price index, and sales is adjusted by producers' price index. Profit is pre-tax. Cash flow is defined as the pre-tax profit plus current-year depreciation. A firm is state (domestic privately/foreign) owned if the paid-in-capital contributed by state (domestic private sector/foreign sector) accounts for more than 50% of its total capital or the largest share of its total capital when none of the three types of investors have a dominant share. Foreign investors include those from Hong Kong, Macao, Taiwan, and all foreign countries

both employment and capital stock, but attain higher sales, reflecting the growth of the economy and of the small firms. Firms are on average somewhat larger in the NE region than outside. NE firms experience a faster growth in capital intensity than other firms, reflected in the larger decrease in the number of employees per unit of capital, plausibly a consequence of the investment tax incentive created by the VAT reform pilot and other preferential policies since 2003. Both capital profitability and cash flow ratio increase substantially over time, but the NE firms lag behind in the entire period.

Appendix Table 7 reports the same statistics by ownership. SOEs are larger (employment, capital stock, and sales) than other types of firms, and they grow even larger during the sample period, reflecting the government strategy to maintain the economic dominance of a small number of large state-owned firms. SOEs, however, are less profitable than other firms and have a lower cash flow ratio. Lower cash flow ratio may also suggest that SOEs have easier access to external credit.

#### 4.4 Firm investment trend: summary and graphical evidence

We now turn to the variable of primary interest: firm gross fixed investment rate. Table 3 reports the investment rate averaged over all firms in each time period, region, and industry combination and number of firms in each category. For each region–industry category, the investment rate increases significantly from the 2001–2003 period to the 2004–2007 period, likely reflecting the aggregate economic trend. For firms in the NE region, the investment rate of firms in the eligible industries increases by 10.83 percentage points more than that of firms in the ineligible industries between the two periods, whereas for firms outside the NE region, the increase in investment rate between the two periods is quite similar between the eligible and ineligible industries: 2.54 percentage points and insignificant. Once we take into account this difference in industrial investment trend in the absence of the VAT reform, the relative growth of investment rate of firms in the eligible industries in the NE region is 8.29 percentage points, significant with a  $t$  statistic of 2.91.

Figure 1 depicts the differences in investment trends between eligible and ineligible firms around the 2004 VAT reform. In the NE region (Panel A), while the investment rate of the eligible and ineligible industries tracks each other closely before 2004, there is a clear divergence after 2004 and especially in 2005 and 2007 with firms in the eligible industries substantially out-investing those in the ineligible industries. The sharp increase in 2007 of both industries in the NE region may be partially attributed to the quick implementation of the policy to exempt tax arrears of all firms in the region. In contrast, outside the NE region (Panel B) the investment rate of firms in the eligible and ineligible industries stays very close over the entire period. Combining Panels A and B, Panel C depicts for each year the difference in the gap of investment rate of NE relative to the non-NE regions between the eligible and ineligible industries, with the value for 2003 normalized to zero. While the relative difference between the two broadly defined industries is quite small over 2001–2003, it grows dramatically over 2004–2007, with NE firms in eligible industries exhibiting significantly larger relative gains.

**Table 3** Average fixed investment rate of firms by region, industry, and year

	NE Region			Non-NE Region		
	2001–2003	2004–2007	Difference	2001–2003	2004–2007	Difference
Ineligible industries	27.45 [3187]	56.68 [6936]	29.24 (5.51)	29.17 [63,892]	42.77 [124,026]	13.6 (17.0)
Eligible industries	33.51 [13,901]	73.58 [36,397]	40.07 (13.12)	29.3 [226,689]	45.44 [551,594]	16.14 (39.45)
DD			10.83 (4.41)			2.54 (1.27)
DDD						8.29 (2.91)

It reports the investment rate averaged over all firms in each time period, region, and industrial eligibility combination. Fixed investment rate is the ratio between gross fixed investment and beginning-of-year net fixed asset stock. Numbers in brackets are the number of firms in each cell; numbers in parentheses are the *t* value indicating the significance of the differences. Sample for non-NE region excludes firms in the 26 cities in Central China where the VAT reform starts in the second half of 2007. See Notes of Table 1 for definition of eligible and ineligible industries

The patterns observed both here and in Table 3 suggest a significant impact of the VAT reform on the investment rate of eligible firms. The regression analysis in the next section demonstrates that this impact is robust to controlling for various confounding factors.

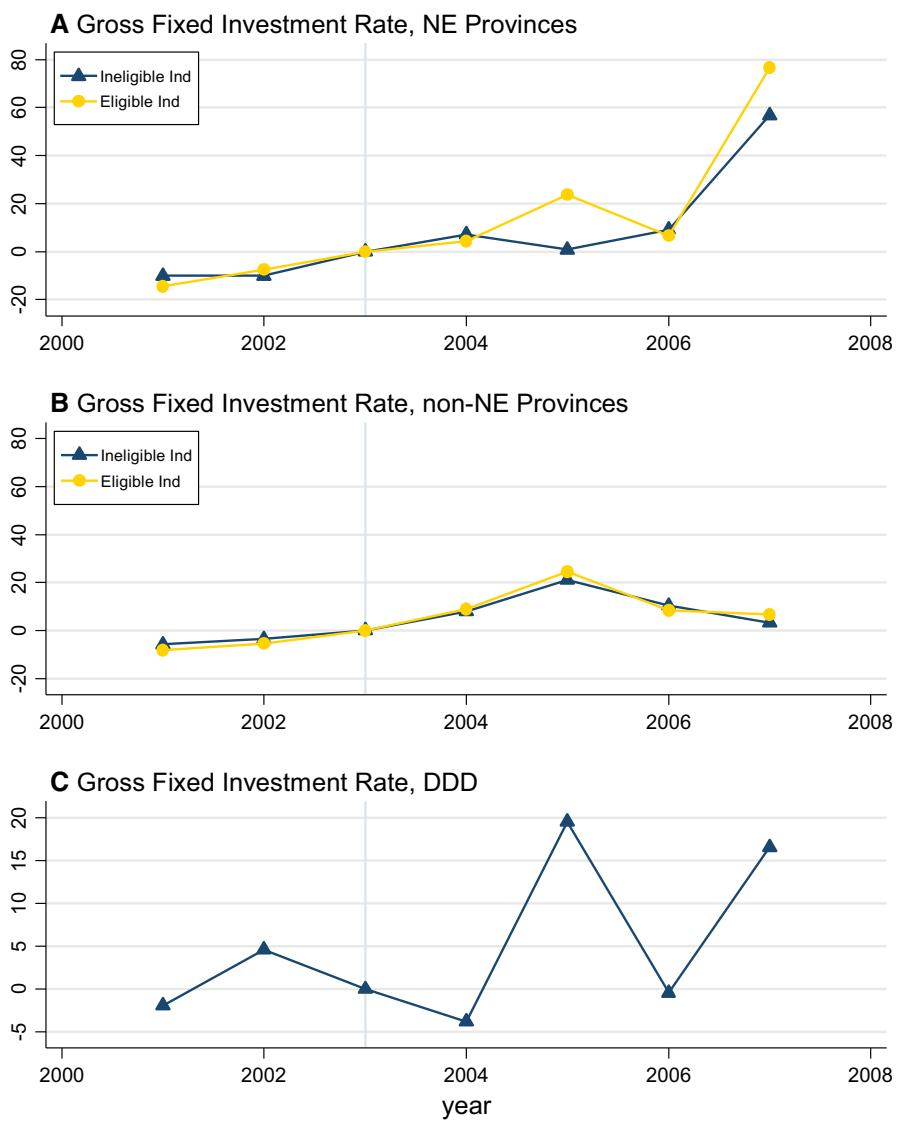
## 5 Impacts of 2004 VAT reform on firm investment

This section presents estimates of the impact of the 2004 VAT reform on the investment rate of eligible firms. We start with estimates of the average effect; robustness analyses indicate that this effect is not driven by preexisting trends or firm expectations. All standard errors are robust and clustered at the province level.

### 5.1 Baseline results

Columns 1–4 of Table 4 report DD estimates for firms in the NE region with those in the eligible industries as treatment group and those in the ineligible industries as control group. Column 1 only controls for indicators for whether a firm is in the eligible industry and whether a year is before 2004 or after; Column 2 controls for a full set of year and industry indicators; Column 3 adds controls for time-varying firm characteristics including cash flow ratio, capital intensity, capital profitability, and indicators for domestic private ownership and foreign ownership.<sup>16</sup> Post-reform,

<sup>16</sup> The eight economic regions specified by the State Council of China are Northern Coastal (Shandong, Hebei, Beijing, and Tianjin), Southern Coastal (Guangdong, Fujian, and Hainan), Eastern Coastal (Shanghai, Jiangsu, and Zhejiang), North East (Liaoning, Heilongjiang, and Jilin), Mid-Yangze Range (Hunan, Hubei, Jiangxi, and Anhui), Mid-Huanghe Range (Shaanxi, Henan, Shanxi, and Inner Mongolia), South West



**Fig. 1** Firm average gross fixed investment rate by region. Notes Each data point in the top two panels is the average of fixed investment rates of all firms in each year-region-industry cell. Each data point in the bottom panel is the difference between the difference in the mid panel and difference in the top panel ( $(Y_{\text{NE-Elig}} - Y_{\text{NE-Inelig}}) - (Y_{\text{non-NE-Elig}} - Y_{\text{non-NE-Inelig}})$ ). Firm fixed investment rate is the ratio between gross fixed investment and beginning-of-year net fixed asset stock of a firm. All values are normalized relative to the value of 2003 in each cell. Sample for non-NE region excludes firms in the 26 cities in Central China where the VAT reform starts in the second half of 2007

**Table 4** Average effect of VAT reform on firm fixed investment rate

	1	2	3	4	5	6	7	8	9	10
After*eligible industry	8.911** [1.077]	8.898*** [0.969]	9.669*** [2.517]	11.21+ [6.438]	2.094 [1.875]	2.324 [1.930]	-0.519 [1.545]	-0.046 [1.831]	9.689*** [4.621]	8.969+
After*NE* eligible industry										
Cash flow ratio	29.755*** [0.739]	30.899*** [1.127]				11.91** [2.129]	16.37*** [2.295]	13.46*** [2.194]	17.30** [2.258]	
Capital intensity	524.76*** [58.441]	669.17* [94.756]				236.88*** [22.73]	458.47*** [37.73]	264.8*** [27.047]	471.1*** [38.588]	
Capital profitability	-0.656 [18.100]	-14.023 [25.911]				17.29* [7.405]	6.582 [8.862]	12.47* [6.070]	6.358 [9.391]	
Domestic private owned	24.47*** [8.618]	11.54 [14.431]				15.25*** [1.99]	1.495 [1.396]	16.44*** [1.493]	1.501 [1.996]	
Foreign owned	-0.368 [4.486]	-21.783 [12.592]				6.369*** [2.016]	4.078* [1.699]	7.326*** [2.582]	2.357 [2.030]	
Constant	50.95*** [6.099]	43.29*** [5.884]	-15.89*** [1.191]	-3.974 [11.32]	33.63*** [2.302]	31.63*** [3.638]	-0.495 [4.167]	7.813 [7.319]	-9.115*** [3.229]	6.733 [6.029]
Observations	60,403	60,403	966,201	966,201			966,201	1,026,604	1,026,604	
# of identifying firms	21,269	5344	304,983				87,700	326,252	93,044	
Firm FE	N	N	N	Y	N	N	Y	N	Y	
Industry FE	N	Y	Y	na	N	Y	na	na	na	
Year FE	N	Y	Y	Y	N	Y	Y	na	na	
Region*industry	na	na	na	na	na	na	na	Y	na	

**Table 4** continued

	1	2	3	4	5	6	7	8	9	10
Year*region	na	Y								
Year*industry	na	Y	Y							

Robust standard errors clustered at province level are in brackets. Columns 1–4 are difference-in-differences (DD) estimates for firms in the NE region. Column 1 only controls for indicators for whether a firm is in the eligible industry and whether a year is 2004 or after; Column 2 controls for a full set of year and industry indicators; Column 3 adds control variables for time-varying firm characteristics; and Column 4 further controls for firm fixed effects. Columns 5–8 are DD estimates for firms in the non-NE region; they follow the same specifications as Columns 1–4. Columns 9–10 are difference-in-differences-in-differences (DDD) estimate of the effect of VAT reform on eligible firms (firms in eligible industries and in NE region) using all firms in the sample. Column 9 controls firm characteristics and a full set of year\*region, year\*industry, and region\*year indicators, where the regions are the 8 economic regions defined by the State Council (see Footnote 16), and the industries are the six broadly defined eligible industries and one ineligible industry. Column 10 controls for firm fixed effects. Sample excludes firms in the 26 cities in Central China where the VAT reform starts in the second half of 2007. See notes of Table 2 for variable definition

\*\*: significant at 1%; \*: significant at 5%; +: significant at 10%

in the NE region, investment of firms in the eligible industries experiences a growth 9.7 percentage points faster than those in the ineligible industries. Estimates are consistent with summary statistics in Table 3.

In Column 4, we control for a full set of firm fixed effects. As is clear from Table 2, many new firms enter the “above scale” sample. Appendix Table 8 shows that just above 50% of all observations are *existing firms*—firms in the sample at least once both before and after the VAT reform in 2004, and these firms tend to be larger and exhibit somewhat lower profitability and sales growth than the overall sample (Column 2). In contrast, Column 4 of Appendix Table 8 shows that 40% of all observations are *entrants*—firms entering the sample in or after 2004; these firms are smaller but have higher profitability and sales growth rate than *existing firms*. By using all firms in the entire sample for identification, the results in Columns 1–3 capture the overall effect of the VAT reform, including that due to firm entry and exit; however, measured firm characteristics may not sufficiently capture potential changes in the relative investment benchmark due to changes in firm composition. To remove the influence of this composition change, we estimate a model controlling for firm fixed effects and report the results in Column 4 of Table 4. The sample that identifies this fixed effect model now includes only the *existing firms*. The estimate on the interaction between post-reform and eligible industry indicators is slightly larger than that in Column 3 but statistically indistinguishable.

Columns 5–8 report estimates from the same specifications for firms outside the NE region. Estimate on the interaction between post-reform and eligible industry indicators is small in magnitude and never statistically significant. Thus, outside the NE region firms in different industries demonstrate indistinguishable investment patterns over time. These regressions can be thought of as placebo tests—since no industries outside the NE region are subject to the VAT reform, the estimate of a null effect provides strong support to our identification strategy.

The DDD specification in Columns 9–10 controls for a full set of year–region, year–industry, and region–industry interactions and time-varying firm characteristics, and Column 10 controls additionally for a full set of firm fixed effects.<sup>17</sup> The point estimate is 9.69 and 8.97, respectively, and both are significant. The estimate is larger without controlling for firm fixed effects, suggesting that in addition to greater within-firm investment increase in eligible firms, within-industry relative investment increase is also larger, which may come from firm churning within an industry such as entry of more productive firms and exit of less productive ones. Evaluated at the average investment rate of eligible firms prior to the reform, the elasticity of investment with respect to the user cost of capital is 1.84,<sup>18</sup> which is quite close to the estimate of

(Guangxi, Yunnan, Sichuan, Chongqing, and Guizhou), and finally, North West (Gansu, Qinghai, Ningxia, Tibet, and Xinjiang).

<sup>17</sup> The numbers of observations in Columns 1–2 and in Columns 3–4 add up to that in Column 7, but the sum of the numbers of firms in Columns 1–2 and 3–4 is greater than that of firms in Column 7. This is because some firms changed industries during the sample period—the same firm can be in one industry in some years and in the other industry in other years. The numbers in Columns 5–6 add up to the respective numbers in Column 7.

<sup>18</sup> This is calculated as  $(8.969/33.5)/(-0.17/1.17)$ , assuming other parameters in Eq. (1) stay the same.

[Zwick and Mahon \(2017\)](#). Firms with larger cash flow and smaller capital intensity tend to invest significantly more, while capital profitability and firm ownership do not appear to affect investment rate.

The DDD estimate reported in Column 10 of Table 4 is likely a lower bound estimate of the effect of the tax credit on eligible firms' investment. The VAT reform applies only to equipment investment; however, due to data limitation, the investment measure in our empirical analysis includes both equipment and structure, attenuating the estimated effect. The effect of the tax credit may also be attenuated due to the specific rule governing the refund of the VAT payment on fixed investment; i.e., eligible firms are only allowed a refund no more than the *increment* of their VAT liability over the previous year.<sup>19</sup> If the current tax liability is not large enough to cover the investment tax credit, the effective cost of marginal investment is  $P(1 + 17\%)$  rather than  $P$ , where  $P$  is the before-tax price of investment goods. Thus, "tax exhausted" firms may be unable to fully benefit from the tax credit.<sup>20</sup> Crude calculation using information on sales, intermediate inputs, and fixed investment and applying a VAT rate of 17% indicates that the tax rebate restriction binds for 61% of NE eligible firms during 2004–2007, who receive an average of 1.18 million Yuan in additional tax savings (present value discounted at an annual rate of 0.03). Since the average of the present value of investment is 24.1 million, firms receive 0.05 Yuan of additional tax savings for each Yuan of investment. In comparison, were the tax rebate limit is set at current VAT liability, assuming the same fixed investment level, then 52% of firms would face a binding rebate constraint, and the average of the present value of additional tax savings would increase to 2.93 million Yuan, or 0.12 Yuan for each Yuan of investment.

Given that the VAT reform is implemented to correct a fundamental distortion in the tax system and is permanent from the perspective of eligible firms, our estimate captures a long-term response of the eligible firms, rather than a short-term shift of investment to the reform period in anticipation of its repeal in the near future. The difference in VAT rate faced by the eligible and ineligible firms is indeed temporary, as the reform was expanded to nationwide a few years later. The assumption we need to identify the tax effect is that ineligible firms lack the ability to predict the timing of this expansion and hence do not temporarily postpone their investment. We deal with the issue of expectation in the following subsection.

<sup>19</sup> On December 27, 2004, December 6, 2005, November 17, 2006, and September 6, 2007, administrative orders were issued jointly by the Ministry of Finance and State Administration of Taxation that VAT on investment goods may be refunded to eligible firms up to their VAT liability. These orders came out perhaps because the authorities had a good sense of the tax revenue toward the year end. These orders were only effective for the remaining days of the respective years (for 2007, it was effective till December 1, 2007). To claim the full credit, firms must file an application and get approval from the provincial tax administration. These orders render the tax rebate constraint somewhat less binding, in particular in later years when firms may form expectations about their issuance.

<sup>20</sup> This is similar to the situations of "tax exhausted" firms in UK under the 1980s corporate income taxation and "tax loss carryforward" firms in the US in the early 1980s and early 2000s. [Auerbach and Poterba \(1987\)](#) and [Altshuler and Auerbach \(1990\)](#) show large variations in the effective tax rates on new investment faced by US firms with different tax liabilities; [Devereux et al. \(1994\)](#) and [Edgerton \(2010\)](#), however, find small effects of this tax asymmetry on the investment of UK and US firms, respectively.

## 5.2 Robustness checks

### 5.2.1 Investment dynamics around the VAT reform

We report the results of the dynamic specification of Eq. (3) in Table 5; all regressions control for firm fixed effects as well as a full set of covariates. Columns 1–2 are results of the DD estimation for firms in and outside the NE region, respectively; Column 3 reports the DDD estimate on the interaction of indicators for years, NE, and eligible industry.

After the reform, in both Columns 1 and 3, the estimate is positive and economically significant for 2005 and 2007 and is also statistically significant for 2007. The negligible estimate in 2004 may be due to the fact that the reform was announced in September 2004, leaving relatively little time for eligible firms to register with the local tax authorities and carry out their investment. Related to this outcome, when we redefine the post-reform period to be 2005–2007, the average effect of tax credit is 12.6 and significant at 10% level. The big drop in 2006 is likely a consequence of the rule restricting tax refund to be below the increment of VAT liability over the previous year. In contrast, the estimate is small and generally insignificant in Column 2.

Leading up to the reform, the investment rate of the eligible firms is not significantly different from that of the ineligible firms. The absence of pre-reform relative investment differences between eligible and ineligible firms indicates that the significant relative increase in investment by eligible firms after 2004 is not a continuation of preexisting differential trends, but more likely due to the VAT reform. The small and insignificant estimates for the years 2001, 2002, and 2004 also suggest that eligible firms did not postpone investment in 2003.<sup>21</sup>

### 5.2.2 Expectations of future tax change

One concern is that ineligible firms may expect the reform to expand to their region or industry soon and thus may postpone their investment purchases in the short run (see, for example, Lucas 1976; Auerbach and Hines 1988). Since we study a time frame shortly after the reform, this waiting behavior may bias our estimate upward. In Sect. 3, we argue that due to uncertainties associated with the initiation and expansion of many of the past economic reform measures, firms' best strategy when faced with a new reform is to maintain a static expectation, rendering the concern less troubling. Here we consider another robustness check. Because the reform was expanded to 26 industrial cities in the six provinces of central China in 2007, it could be that there had been internal discussions about the forthcoming expansion, which may be conveyed to the firms in the region; therefore, these firms may expect the expansion to reach them very soon. As a result, including firms in the six central provinces in the control group may lead to overestimation of the effect of the VAT reform. In the main

<sup>21</sup> The popular *Caijing Magazine* (Economy and Finance) in its June 05, 2004, issue reported that since the second half of 2003, “investment overheating” had become the buzz word in the news media and research reports, and the push for the VAT reform had become considerably weaker. These greatly delayed the implementation of the reform.

**Table 5** Dynamic effects of VAT reform on firm fixed investment rate

	1 NE	2 non-NE		3 All
Eligible ind*2001	1.74 [1.994]	0.2291 [1.152]	NE*eligible ind*2001	2.2242 [3.143]
Eligible ind*2002	0.33 [9.167]	0.0872 [1.008]	NE*eligible ind*2002	1.4432 [7.109]
Eligible ind*2004	3.0798 [5.783]	-0.7046 [1.959]	NE*eligible ind*2004	1.2962 [4.970]
Eligible ind*2005	24.0929 [17.786]	3.0869 [3.451]	NE*eligible ind*2005	19.5961 [14.316]
Eligible ind*2006	-2.0709 [15.866]	-3.5118* [1.396]	NE*eligible ind*2006	-0.1284 [12.939]
Eligible ind*2007	24.8344 <sup>+</sup> [8.136]	1.3119 [2.704]	NE*eligible ind*2007	22.1142** [6.894]
Constant	-4.4125 [12.878]	7.7139 [7.594]		6.7399 [6.018]
Observations	60,403	966,201		1,026,604
Number of firms for identification	5,344	87,700		93,044

Robust standard errors clustered at province level are in brackets. Columns 1–2 are DD estimates for firms in the NE region and non-NE region, respectively, controlling for time-varying firm characteristics, a full set of year indicators, and firm fixed effects—the same specification as in Columns 4 and 8 of Table 4. Column 3 is DDD estimates for all firms, controlling for firm characteristics, a full set of year\*region, year\*industry, and firm fixed effects—the same specification as Column 10. See notes of Table 4 for definitions of region, industry, and control variables

\*\* significant at 1%; \* significant at 5%; + significant at 10%

regressions, we exclude firms in the 26 cities in central China; we further address the concern of expectations by performing DDD estimation dropping all firms in the six central provinces from the control group. The estimate on the interactive term is 8.78, significant at 10% level, and is not statistically different from the estimate in Column 10 of Table 4. This raises our confidence that the baseline results are not driven by the expectation formation process just described.

## 6 Financial constraint and heterogeneous responses to tax credits

In the above analyses, we show that *ceteris paribus* financial constraints as measured by cash flow ratio significantly affect firm investment. Financial constraints may also affect to what extent firms are able to take advantage of the investment tax incentives. Using US data, Edgerton (2010) finds that investment incentives are less effective when firm financial constraints are tight; Becker et al. (2013) report that payout tax has a larger negative effect on investment of firms that have smaller cash flows; Zwick and Mahon (2017), however, find that financially constrained firms respond *more* to tax incentives if they generate immediate cash flows. In a developing country context,

[Hsieh and Parker \(2007\)](#) find that Chilean aggregate investment increases substantially following a large reduction of taxation on retained profits; and the increased investment is entirely funded by the increase in retained profits.

Due to the underdevelopment of the financial market in China, firm responses to VAT investment tax credits are likely to be sensitive to internal funds availability. The direction of the influence, however, is uncertain. On the one hand, cash-constrained firms may be more likely to take this opportunity to attain optimal investment because they have not been able to do so prior to the policy change. On the other hand, cash-constrained firms may not be able to finance the potentially large amount of investment expenses induced by the tax credits. We investigate the heterogeneity of firm responses by splitting the sample along different proxies of ex ante financial constraints used in the literature.

## 6.1 Heterogeneous responses by firm size and cash flow

Following [Edgerton \(2010\)](#) and [Zwick and Mahon \(2017\)](#), which find that small firms are more responsive to investment tax credits, we first consider responses of firms of different sizes. We report DDD estimates on the interaction between eligible industry, NE region, and post 2004 indicators in Panel A of Table 6; all controls in Column 10 of Table 4 are included.

Column 1 reports the result for a balanced panel of firms—firms that are in the sample for all 7 years; as shown in Appendix Table 8, these firms tend to be much larger than other firms and have moderate profitability and sales growth rate. Focusing on this sample also allows us to further remove the impact due to firm entry and exit. The point estimate is 5.93 and significant at the 5% level; the corresponding user cost elasticity is 1.44, considerably smaller than that for the entire sample.

We next group firms in the balanced panel based on their employment or capital stock level in 2004 by ownership. As reported in Columns 2–3, for firms with less than median employment in 2004, the point estimate is 8.56 and significant at 10% level, corresponding to a user cost elasticity of 2.21. In contrast, the estimate for the sample of firms with above-median employment in 2004 is much smaller and statistically insignificant. Similarly, as reported in Columns 4–5, eligible firms with less than median capital stock in 2004 exhibit significant increase in investment rate after the VAT reform, whereas for eligible firms with more than median capital stock, the point estimate is negative but insignificant.

The differential responses by firm size appear to be a consequence of the difference in internal funds availability of firms of different sizes. As reported in Appendix Table 8, the cash flow ratio of the balanced sample is 0.42 compared to 0.48 for the entire sample. Moreover, the cash flow ratio is 0.35 and 0.48 for firms of above- and below-median employment, respectively, and 0.3 and 0.54 for firms of above- and below-median capital stock, respectively. In Panel B, we report directly estimates of the response of firms with below- and above-median cash flow ratio in 2004 by ownership. For firms with above-median cash flow ratio, the estimate on the interactive term is 16.97 and significant at the 1% level, whereas for firms with below-median cash flow ratio, the estimate is indistinguishable from zero. These results are consistent with the

**Table 6** Heterogeneity effect of VAT reform on firm fixed investment rate

	1	2	3	4	5
Balanced panel	Employment		Capital stock		
	<median in 2004	> median in 2004	<median in 2004	> median in 2004	> median in 2004
<b>A. Firm size</b>					
After*NE*eligible industry	5.9307** [1,837]	8.5607* [3,722]	2.5258 [4,688]	17.3096** [2,568]	-5.4675 [3,380]
Observations	231,014	115,542	115,472	115,423	115,591
<b>B. Firm cash flow ratio</b>					
After*NE*eligible industry	-0.71 [2,644]	16.97*** [2,154]	115,101	115,913	115,913
Observation		1	2	2	2
<b>C. Firm ownership</b>					
After*NE*eligible industry	12.4820** [4,182]	10.2124+ [5,969]	71,989	775,442	775,442
Observation		SOE	Domestic private		

Robust standard errors clustered at province level are in brackets. All estimates are DDD estimates, controlling for a full set of year\*region, year\*industry, and firm fixed effects and time-varying firm characteristics. Panels A and B use a balanced panel of firms that are in sample for all 7 years. In Panel A, Columns 2 and 3 employ, respectively, the sample of firms that have below- and above-median employment level in 2004 by ownership; Columns 4 and 5 employ, respectively, the sample of firms that have below- and above-median capital stock in 2004 by ownership. In Panel B, Columns 1–2 employ, respectively, the sample of firms that have below- and above-median cash flow ratio in 2004 by ownership. Panel C uses the full sample. See notes of Table 4 for definitions of region, industry, and control variables

\*\* significant at 1%; \* significant at 5%; + significant at 10%

fact that the benefit provided by the VAT reform does not realize upfront—firms pay the VAT when they purchase the investment goods and receive a tax reduction only when they sell their products, causing firm response to investment tax incentives to be constrained by the size of internal funds. Since size and cash flow ratio may be correlated with many other firm characteristics, the results here are only suggestive, and further analysis is necessary to better understand the interactions between tax policies, financial constraints, and firm investment.

Finally, consistent with findings of early research, the weak responses to investment tax credits by larger firms suggest that investment tax credits may not be an effective policy tool to stimulate aggregate investment. Indeed, when we aggregate firm data to province–industry level and estimate Eq. (3), the point estimate on the interaction between eligible industry, NE region, and post 2004 indicators is an insignificant 1.85.

## 6.2 Heterogeneous responses by firm ownership

In this section, we use firm ownership as an alternative proxy for financial constraint. One important feature of the Chinese economy is that the state-owned enterprises (SOEs) and firms of other ownerships have dramatically different access to external funds. On the one hand, SOEs regularly enjoy easy access to bank loans and are also able to finance large-scale investment projects through earmarked treasury bonds; thus, they are unlikely to experience financial constraints. On the other hand, domestic private firms are considered to be much riskier because of their short credit history and lack of chances of bailout by the government in case of financial difficulties; therefore, they usually have difficulties obtaining bank loans and rely more heavily on retained earnings (Allen et al. 2005; Guariglia et al. 2011).

We estimate the DDD model for SOEs and domestic private firms separately and report the results in Panel C of Table 6.<sup>22</sup> The point estimates for SOEs and domestic private firms are quite close, at 12.48 and 10.21, respectively, and both are significant; since the eligible SOEs have much lower investment rate prior to the tax reform than eligible private firms, the user cost elasticity of investment differs substantially, at 7.36 and 1.64. The similarity in the response to the VAT tax credits by the domestic private firms and the SOEs is partially a consequence of domestic private firms' strong cash flow position; the cash flow ratio is 0.5 and 0.14 for the domestic private firms and SOEs, respectively. Not reported, cash flow ratio itself has a stronger effect on the investment of private firms than SOEs, the point estimate being 20.01 and 9.27, respectively.

The fact that domestic private firms respond to the VAT reform in the predicted manner and the elasticity estimate is quite close to the estimate of Zwick and Mahon (2017) increases our confidence that our estimated policy effect is not driven by potential preferential treatments of SOEs; on the contrary, the estimate reported in Sect. 5 is largely driven by the domestic private firms given the magnitude of the private sector

<sup>22</sup> All FDIs receive special tax treatment of their fixed investment till 2009; in particular, if they purchase domestically manufactured fixed investment goods, the VAT on these is deductible from their VAT liability on the final output. Estimation results for FDIs show that they are virtually not affected by the VAT reform pilot.

in manufacturing industries. Because private firms in China operate in a largely competitive, albeit far from perfect, market, our results bear general implications for tax reforms that are potentially relevant to other developing countries in a similar stage of market development.

## 7 Conclusion

To facilitate the transition of economic growth from one of labor-driven to one where technology plays a more important role, the Chinese government launched an important tax reform in the mid 2000s—the conversion of the value-added tax from one of production type to consumption type—as an effort to provide more incentives to firms to invest in new equipment that may embody new technologies. This paper estimates the impact on firm fixed investment of the investment tax credit provided by China's 2004 VAT reform pilot. We find that the tax credit has a positive and significant impact on the fixed investment expenditure of eligible firms. Our heterogeneity analyses suggest that the investment tax incentive has larger effects on firms that are less financially constrained such as smaller firms and firms with a larger cash flow. The finding that domestic private firms respond significantly to the tax incentives is partially due to their large cash flow; it also suggests that our results have broader implications for policy making in countries at similar development stages.

We interpret our estimates as the effect of tax credit on the investment of eligible firms, and they provide useful insights into possible impacts of the nationwide expansion of the VAT reform in 2009. Yet, one should exercise caution in drawing quantitative implications for national reforms from the estimates here. For example, investment may shift from ineligible to eligible regions or from ineligible to eligible industries under a partial reform, which is not possible in a national reform. The supply-side response may also be quite different in a national reform from a local experiment.

Given that we find in this paper that VAT reform has induced more investment of eligible firms, future research will investigate whether this increased investment has translated into higher productivity. In addition, future research will also examine the composition of the newly purchased investment goods: Do they embody more advanced technologies? This will provide additional insights into the mechanisms of productivity gains and economic growth.

**Acknowledgements** We thank Alan Auerbach, Hong Ma, Jim Poterba, Kevin Tsui, Jing Xing, and seminar participants of 71st IIPF Annual Congress, Public Finance Issues in China conference, Shanghai Jiaotong University, Tongji University, and the UC-Berkeley Public Finance Lunch for helpful comments. Part of this research was completed while Lei Zhang was visiting the Burch Center for Tax Policy and Public Finance at the Economics Department of UC-Berkeley.

## 8 Appendix

See Appendix Tables 7, 8 and Fig. 2

**Table 7** Summary statistics of main firm characteristics by ownership

	All Firms						Firms in Northeastern (NE) Region					
	Employment	Net fixed asset stock (NFAS)	Sales 1000 Yuan	Capital intensity (emp./NFAS)	Capital profitability (profit/total asset)	Cash flow ratio (CF/NFAS)	Employment	Net asset stock (NFAS)	Sales 1000 Yuan	Capital intensity (emp./NFAS)	Capital profitability (profit/total asset)	Cash flow ratio (CF/NFAS)
<b>SOE</b>												
2001	593.6	61785.2	72711.9	0.046	-0.006	0.080	802.3	99915.7	73673.2	0.057	-0.015	0.037
2002	598.2	75869.6	101191.5	0.042	-0.003	0.100	804.2	124037.6	138750.6	0.052	-0.011	0.044
2003	619.0	88978.7	128293.2	0.041	0.000	0.122	863.2	151654.5	203335.1	0.049	-0.013	0.052
2004	633.6	94654.4	159852.5	0.039	0.003	0.160	745.0	110835.8	218552.7	0.046	-0.009	0.121
2005	551.8	96642.0	207891.1	0.040	0.009	0.188	546.2	93575.1	176198.5	0.045	-0.002	0.151
2006	592.6	134975.3	299111.1	0.036	0.011	0.241	788.9	167819.4	380757.5	0.038	-0.012	0.135
2007	707.2	189544.4	556794.1	0.033	0.028	0.351	999.9	249140.8	1555725	0.033	0.016	0.257
Total	607.3	94183.7	173132.6	0.041	0.003	0.150	787.6	132189.8	285239.5	0.048	-0.009	0.093
<b>Domestic Private</b>												
2001	273.6	18894.6	46683.7	0.066	0.063	0.378	380.7	28869.4	54401.9	0.077	0.052	0.343
2002	251.1	18318.5	49578.8	0.069	0.071	0.412	320.7	28863.2	52359.1	0.064	0.054	0.302
2003	248.7	19184.1	52255.2	0.067	0.071	0.439	306.6	29614.1	53940.8	0.063	0.045	0.308
2004	241.8	20268.7	58782.9	0.062	0.072	0.465	271.3	26675.5	52684.3	0.058	0.045	0.325
2005	199.7	17108.7	57143.0	0.064	0.077	0.480	213.9	23642.0	55946.3	0.052	0.049	0.381
2006	205.6	21298.9	87103.9	0.054	0.093	0.545	204.9	27583.3	70975.8	0.043	0.059	0.373
2007	195.6	21023.0	95615.4	0.051	0.102	0.586	182.6	26125.0	76671.6	0.040	0.067	0.419

**Table 7** continued

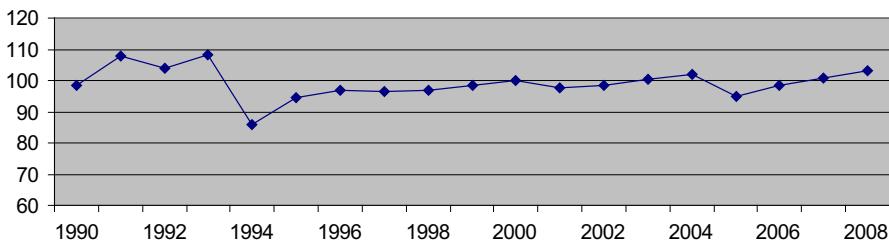
All Firms							Firms in Northeastern (NE) Region				
Employment	Net fixed asset stock (NFAS)	Sales 1000 Yuan	Capital intensity (emp./NFAS)	Capital profitability (profit/total asset)	Cash flow ratio (CF/NFAS)	Net fixed asset stock (NFAS)	Employment	Net fixed asset stock (NFAS)	Sales 1000 Yuan	Capital intensity (emp./NFAS)	Capital profitability (profit/total asset)
Total	220.1	19665.1	70168.9	0.060	0.083	0.498	237.1	26795.7	63760.0	0.051	0.056
FDI											0.367
2001	357.9	37017.4	93639.4	0.061	0.044	0.383	422.8	54406.8	106371.8	0.031	0.052
2002	349.4	37471.3	106197.9	0.063	0.043	0.417	382.3	53547.3	106941.8	0.032	0.041
2003	360.1	37624.6	114418.9	0.064	0.048	0.449	384.3	54470.8	115789.8	0.038	0.043
2004	383.1	37368.7	130733.1	0.067	0.054	0.507	343.7	52729.7	129224.2	0.036	0.052
2005	355.8	34558.5	133051.7	0.069	0.050	0.505	306.3	44730.6	119632.7	0.039	0.047
2006	385.9	40926.9	171125.8	0.062	0.061	0.580	324.4	46397.2	132828.0	0.042	0.048
2007	392.5	43663.0	215559.3	0.059	0.066	0.641	290.0	44163.2	224892.2	0.039	0.044
Total	372.9	38912.6	150241.3	0.064	0.055	0.525	334.5	48487.9	145742.5	0.038	0.046
											0.461

Same as notes of Table 2

**Table 8** Characteristics of different samples of firms

	1	2	3	4
	All	In sample at least once before and after 2004	Balanced panel	Enter sample in or after 2004
Employment	273.9	352.3	431.0	177.1
Net fixed asset stock	27829.6	37694.2	49025.8	17091
Cash flow ratio	0.478	0.437	0.415	0.564
Capital profitability	0.072	0.063	0.060	0.091
Annual sales growth	0.358	0.263	0.234	0.58
No. of Observations	1,026,604	522,250	231,014	430,650

This table describes the main characteristics of firms that are in the sample for different periods of time. Firms in Column 2 are the identifying sample of the model controlling for firm fixed effects. Firms in Column 3 are firms that are in the sample for the entire period of study; they are larger but with moderate profitability and sales growth compared to other firms. See notes of Table 2 for definitions of firm ownerships, net fixed asset stock, cash flow ratio, and capital profitability. Annual sales growth is the difference between current and previous year sales divided by previous year sales

**Fixed Investment Price Index**

**Fig. 2** Fixed Investment Price Index, China 1990–2008. Notes The data source is China Statistical Yearbook, 2009, by the National Bureau of Statistics of China. The mean of FIPI over the entire period is 99.1; SD is 4.9; minimum is 85.9 reached in 1994; and maximum is 108.2 reached in 1993

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