Corporate investment and expropriation by controlling shareholders: Evidence from Chinese listed companies[1]

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Abstract

This paper presents a dynamic model that establishes the relationship between corporate investment and expropriation by controlling shareholders for firms facing different financing constraints. Using data on Chinese listed companies, we empirically test the model's predictions about the effects of expropriation on inefficient investment in various periods. We find that firms with less tight financing constraints overinvest in the pre-expropriation period if the intended expropriation level is lower than a threshold, but underinvest if the expropriation level exceeds the threshold. However, expropriation does not impact inefficient investment in the expropriation and post-expropriation periods, even after the sanctions on these firms for expropriation are imposed. For firms with tight financing constraints, while expropriation does not significantly impact inefficient investment in the pre-expropriation period, it further tightens firms' financing constraints in the expropriation and post-expropriation periods, leading to underinvestment. Moreover, investment is reduced after the sanctions on firms for expropriation are imposed and announced to the public.

Keywords: inefficient investment; controlling shareholder; tunneling
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1. Introduction

It is observed that in most countries corporate ownership is concentrated rather than widely dispersed with control of most firms in the hands of controlling shareholders, who often are firms' founding members and are entrenched (La Porta et al., 1999). As pointed out by La Porta et al. (2002), controlling shareholders have the incentive and power to extract gains from minority shareholders, a phenomenon referred to as expropriation or tunneling (Aslan and Kumar, 2012; Johnson et al., 2000).[2] Tunneling is a manifestation of the agency problems described by Jensen and Meckling (1976), and can take a variety of forms, such as outright theft or fraud, transfer of corporate funds and assets through self-dealing transactions, inside trading, as well as investor dilution, to name just a few. Tunneling is particularly pronounced in China, given the highly concentrated ownership structure and lack of a sound corporate governance mechanism in most Chinese listed firms. For instance, from 2003 to 2013, the China Securities Regulatory Commission (CSRC) as well as the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE) investigated and punished 451 instances of expropriation, involving an amount of RMB 144.53 billion (approximately US $23.3 billion) and 423 listed companies.[3] Tunneling by controlling shareholders leads to a great variation in investment in these firms. In this paper we are interested in exploring how corporate investment decisions are distorted as a result of tunneling or intention to tunnel by controlling shareholders in listed firms.

As is well known, corporations select an investment level to maximize firm value under perfect market assumptions (Hayashi, 1982). However, in reality, a corporation's investment is largely distinct from this optimal level due to market imperfections, such as information asymmetries and agency problems (Aggarwal and Samwick, 2006; Bertrand and Mullainathan,

[2] The terms expropriation and tunneling are used interchangeably in this paper.
[3] Source: CSMAR database.

2003; Hart and Moore, 1995; Stulz, 1990), resulting in either over- or underinvestment (referred to as inefficient investment).[4] For example, Myers and Majluf (1984) document that in the presence of asymmetric information, firms may forgo valuable investment opportunities, leading to underinvestment. Some recent studies in this area shed light on the relation between inefficient investment and expropriation by controlling shareholders by empirically examining how the ownership structure, the degree of separation of ownership and control, and the quality of corporate governance impact corporate investment decisions, but report conflicting results. For example, some work finds that tunneling by controlling shareholders in listed firms boosts the cost of external financing (Aslan and Kumar, 2012; Gilson, 2006; Jiang et al., 2010; Johnson et al., 2000), which negatively impacts firm investment. Bertrand and Mullainathan (2003) and Giroud and Mueller (2010) document that firms with poor corporate governance tend to underinvest.

On the other hand, Wu and Wang (2005) find that firms may have incentives to overinvest in order to obtain large private benefits of control. Lan and Wang (2003) share a similar view, and regard both diverting cash away from firms and overinvesting as two ways used by controlling shareholders to pursue private benefits. Billett et al. (2011) and Albuquerque and Wang (2008) find that firms with poor investor protection and corporate governance are likely to overinvest.

While it is widely documented in the literature that inefficient investment serves as a channel for the controlling shareholder in a firm to pursue her own private benefits, the intertemporal implications of tunneling for investment have not been formally analyzed either theoretically or empirically. In contrast with previous studies, this paper proposes a three-period model to explore a corporation's investment behavior not only at the time when expropriation occurs but

[4] Over- and underinvestment is inefficient, as they reduce a firm's value. In practice, inefficient investment may be caused by many factors; expropriation is one of them.

also before and after the expropriation date. In particular, we intend to derive an explicit relation between firms' inefficient investment and the fraction of output expropriated by controlling shareholders in three different periods: pre-expropriation, expropriation, and post-expropriation. Investment decisions may be distorted intertemporally as a result of expropriation or the intention to expropriate in the future. In the pre-expropriation period, firms' investment depends not only on investment opportunities, but also on how investment impacts future tunneling benefits and costs. In the expropriation period, tunneling reduces internal funds available for investment, which in turn impacts firm investment and financing behavior, while in the post-expropriation period, firms will have to bear the high external financing cost as a consequence of tunneling practices, and invest accordingly. In addition, the impacts of tunneling on investment depend critically on the tightness of financing constraints faced by the firms. By incorporating an additional cost for external financing into the model, we are able to explain the heterogeneity of investment behavior for firms facing different financing constraints. Our model can help us better understand how and why tunneling impacts a firm's dynamic investment decision as well as the consequence of tunneling practices. This explains why the previous research on inefficient investment and expropriation provides conflicting findings.

Using the data on Chinese listed firms, we empirically test various hypotheses regarding inefficient investment and tunneling that are developed based on our model. To this end, following Richardson (2006), we measure inefficient investment as the difference between a firm's total investment and its expected investment in a particular year. We adopt the difference-in-differences method (Ashenfelter and Card, 1985) to examine how inefficient investment is related to tunneling in various periods. Specifically, we classify firms into two groups: those with and without tunneling activities, and then compare the inefficient investments in the two groups

to gauge the tunneling effect. To address the endogenous problem due to observable variables, we use the propensity score matching method to pair firms with and without tunneling activities (Rosenbaum and Rubin, 1983). In contrast with the event study method used in most previous studies (McNichols and Stubben, 2008), the difference-in-differences method is able to correct for sample selection biases (Heckman, 1979) by isolating the tunneling effect from the effects of other factors on inefficient investment.

Our research also adds to the literature on the relation between corporate ownership structure and firm value. Previous studies on this subject generally highlight both the positive and negative effects of managerial ownership on valuation of firms (Morck et al., 1988). On one hand, a larger ownership of a firm held by its controlling shareholder helps diminish the incentives of the firm's controlling shareholder to expropriate other investors, and thereby is associated with higher valuation (Jensen and Meckling, 1976). This is supported by the empirical evidence of higher valuation in firms with higher cash-flow ownership by controlling shareholders (La Porta et al., 2002). On the other hand, stronger entrepreneurial control adversely affects valuation (Claessens et al., 2002). Our focus is on the firms' distorted investment decisions as a result of expropriation that is caused by the divergence of control rights and cash flow rights, which in return translates into a reduced firm value.

We find that firms with less tight financing constraints overinvest in the pre-expropriation period if the intended expropriation level in the future is lower than a threshold, but underinvest if the intended expropriation level exceeds the threshold. However, expropriation does not impact inefficient investment in the expropriation and post-expropriation periods for this type of firms. For the firm with tight financing constraints, while our model predicts that expropriation leads to a reduction in investment even underinvestment in the pre-expropriation period, our

empirical results do not provide evidence in support of this prediction due to the fact that the financing constraints faced by most Chinese listed firms are typically not sufficiently tight. In addition, we show that expropriation leads to underinvestment in the expropriation and post-expropriation periods for firms with relatively tight financing constraints, and investment is further reduced after the sanctions on firms for expropriation are imposed and announced to the public.

The remainder of this paper is organized as follows. Section 2 presents the model and characterizes a firm's dynamic investment behavior due to expropriation by the controlling shareholder. Section 3 describes the research methodology. Section 4 discusses the data used in this study. Section 5 analyzes the empirical results. Section 6 provides robustness tests, while Section 7 concludes the paper.

2. The model

2.1. The model

Consider a firm that is fully controlled by a single major shareholder, referred to in this paper as the controlling shareholder, who has cash-flow or equity ownership α in the firm. The controlling shareholder exerts her control by owning a large fraction of the firm's voting rights, which is higher than the fraction of cash-flow rights (La Porta et al., 1999). We assume that the controlling shareholder is the manager.

There are four dates, t = 1, 2, 3, and 4, which define three periods: period i from date i to i+1 (i=1, 2, and 3). During period 1, the controlling shareholder has the intention to expropriate minority shareholders, but has not taken any actions yet. During period 2, the controlling shareholder is expropriating minority shareholders to obtain private benefits of control, while

period 3 is the post-expropriation period. Following the neoclassical investment modelling approach, we further assume:

(1) The firm's profits at date t is $\Pi(K_t) = \pi K_t$ ($t = 1,2,3,4$), where K_t is the firm's capital level at the beginning of period t, and π represents the capital return in the period.

(2) During period 2, the controlling shareholder diverts a fraction s of profits Π_2 to herself $s\Pi_2$. $s \in (0,1)$ is referred to as the expropriation level. As pointed out by La Porta et al. (2002), much of such diversion requires costly transactions. Following La Porta et al. (2002), the cost of expropriation is specified as $C(s,\Pi_2) = \frac{1}{2}\theta s^2 \Pi_2$, where θ is the degree of shareholder protection in the country/region where the firm operates. Intuitively, firms that operate under a more protective legal system pay a higher cost for expropriating a given share of profits. In addition, consistent with the law of diminishing productivity, the marginal cost of expropriation is assumed to be an increasing function of the expropriation fraction s.

(3) Capital at the end of period t is equal to the capital at the beginning of the period plus new investment I_t, minus capital depreciation during the period. If the rate of depreciation is δ, then we have $K_{t+1} = I_t + (1-\delta)K_t$.

(4) New investment incurs costs of adjusting the firm's capital stock, such as fees for installing new equipment and training workers. In this paper, the adjustment cost is assumed to be $\Phi(I_t, K_t) = \frac{\phi}{2}(I_t/K_t)^2 K_t$, where ϕ is the rate of investment cost and $\phi > 0$.

(5) New investment can be financed by internally-generated funds, which are the firm's after-tax profits after subtracting the expropriation amount. However, external financing has to be obtained if $(1-s_t)\Pi(K_t) < I_t + \Phi(I_t, K_t)$, where s_t is the expropriation level at date t, and $s_2 = s > 0$ as well as $s_1 = s_3 = s_4 = 0$. Thus, the amount of external financing is given by $F_t = I_t + \Phi(I_t, K_t) - (1-s_t)\Pi(K_t)$. The cost of external financing is defined as $\Psi(F_t, K_t) = \frac{\varphi_t}{2}(F_t / K_t)^2 K_t$, where φ_t is the rate of financing cost and $\varphi_t > 0$.

The controlling shareholder/manager selects the amount of investment in each period to maximize her private benefits:

$$\begin{aligned}\max_{I_1, I_2, I_3, s} E(U) = {} & \alpha\left[\Pi(K_1) - I_1 - \Phi(I_1, K_1) - \Psi(F_1, K_1)\right] + R\{\alpha[(1-s)\Pi(K_2) - I_2 \\ & - \Phi(I_2, K_2) - \Psi(F_2, K_2)] + s\Pi(K_2) - C(s, \Pi(K_2))\} \\ & + R^2\{\alpha[\Pi(K_3) - I_3 - \Phi(I_3, K_3) - \Psi(F_3, K_3)]\} \\ & + R^3\alpha[\Pi(K_4) + (1-\delta)K_4)], \end{aligned} \tag{1}$$

S.t.

$$K_{t+1} = I_t + (1-\delta)K_t,$$

$$F_t = \begin{cases} I_t + \Phi(I_t, K_t) - (1-s_t)\Pi(K_t), & I_t + \Phi(I_t, K_t) - (1-s_t)\Pi(K_t) > 0 \\ 0, & I_t + \Phi(I_t, K_t) - (1-s_t)\Pi(K_t) \le 0 \end{cases},$$

where R is the discount factor.

If the manager acts in the best interest of all shareholders, no expropriation occurs and the investment decision is determined by maximizing the firm value:

$$\begin{aligned}\max_{I_1, I_2, I_3} E(U) = {} & \Pi(K_1) - I_1 - \Phi(I_1, K_1) - \Psi(F_1, K_1) + R[\Pi(K_2) - I_2 - \Phi(I_2, K_2) - \Psi(F_2, K_2)] \\ & + R^2[\Pi(K_3) - I_3 - \Phi(I_3, K_3) - \Psi(F_3, K_3)]\end{aligned}$$

$$+ R^3\left[\alpha\Pi(K_4) + (1-\delta)K_4)\right], \tag{2}$$

S.t.

$$K_{t+1} = I_t + (1-\delta)K_t,$$

$$F_t = \begin{cases} I_t + \Phi(I_t, K_t) - \Pi(K_t), & I_t + \Phi(I_t, K_t) - \Pi(K_t) > 0 \\ 0, & I_t + \Phi(I_t, K_t) - \Pi(K_t) \le 0 \end{cases}.$$

Apparently, the investment decisions based on model (1) could be substantially different from the decisions based on model (2), giving rise to inefficient investment. Our model also indicates that the distorted investment decision as a consequence of tunneling or intention of tunneling by the control shareholder reduces firm value. This represents an additional cost to minority shareholders in addition to the portion of profits expropriated by the controlling shareholder.

Chirinko and Schaller (2004) document that for firms with serious cash flow agency problems (Jensen, 1986), corporate decisions are based on the lower executives' expected return as opposed to the shareholders' return. However, in our setting, the distorted investment decisions are an outcome of the controlling shareholder's attempt (or practice) to expropriate minority shareholders, and are not due to the lower discount rate used by the controlling shareholder.

2.2. Corporate investment and expropriation in the absence of financing constraints

If a firm faces no financing constrains, i.e., $\varphi_t = 0$, then the optimal investment levels with and without tunneling in each period can be solved from models 1 and 2:

- Optimal investment without expropriation in period 1:

$$\left(\frac{I_1}{K_1}\right)^* = \frac{1}{\phi}\left\{R\left[\pi + \frac{\phi}{2}\left(\frac{I_2}{K_2}\right)^{*2}\right] + R^2(1-\delta)\left[\pi + \frac{\phi}{2}\left(\frac{I_3}{K_3}\right)^{*2}\right] + R^3(1-\delta)^2(\pi + 1 - \delta) - 1\right\}. \tag{3}$$

- Optimal investment with expropriation in period 1:

$$\left(\frac{I_1}{K_1}\right)_s = \frac{1}{\phi}\left\{R\left[\pi + \frac{\phi}{2}\left(\frac{I_2}{K_2}\right)_s^2 + \frac{1-\alpha}{\alpha}s - \frac{\theta}{2\alpha}s^2\right]\right.$$

$$\left. + R^2(1-\delta)\left[\pi + \frac{\phi}{2}\left(\frac{I_3}{K_3}\right)_s^2\right] + R^3(1-\delta)^2(\pi+1-\delta) - 1\right\}. \quad (4)$$

- Optimal investment without expropriation in period 2:

$$\left(\frac{I_2}{K_2}\right)^* = \frac{1}{\phi}\left\{R\left[\pi + \frac{\phi}{2}\left(\frac{I_3}{K_3}\right)^{*2}\right] + R^2(1-\delta)(\pi+1-\delta) - 1\right\}. \quad (5)$$

- Optimal investment with expropriation in period 2:

$$\left(\frac{I_2}{K_2}\right)_s = \frac{1}{\phi}\left\{R\left[\pi + \frac{\phi}{2}\left(\frac{I_3}{K_3}\right)_s^2\right] + R^2(1-\delta)(\pi+1-\delta) - 1\right\}. \quad (6)$$

- Optimal investment without expropriation in period 3:

$$\left(\frac{I_3}{K_3}\right)^* = \frac{1}{\phi}\left[R(\pi+1-\delta) - 1\right]. \quad (7)$$

- Optimal investment with expropriation in period 3:

$$\left(\frac{I_3}{K_3}\right)_s = \frac{1}{\phi}\left[R(\pi+1-\delta) - 1\right]. \quad (8)$$

- Optimal expropriation level from model 1:

$$s^* = \frac{1-\alpha}{\theta}. \quad (9)$$

Based on Equations (3) – (8), we have the following proposition:

Proposition 1. In the absence of financing constraints, expropriation by the controlling shareholder in a firm does not cause changes in investment in periods 2 and 3, but it leads to inefficient investment in period 1. The inefficient investment in period 1 is given by:

$$\Delta_{1s} = \left(\frac{I_1}{K_1}\right)_s - \left(\frac{I_1}{K_1}\right)^* = \frac{R}{\phi}\left[\frac{1-\alpha}{\alpha}s - \frac{\theta}{2\alpha}s^2\right]. \tag{10}$$

Proposition 1 indicates that in order to better obtain the benefits from expropriation, the controlling shareholder deviates from the optimal investment during the pre-expropriation period to adjust corporate capital stock and output in the expropriation period. However, during the expropriation and post-expropriation periods, investment is maintained at the optimal level, as deviations from the optimal level do not impact assets and output that can be expropriated in the expropriation period. Thus, the intention of the controlling shareholder to expropriate minority shareholders explains pre-expropriation inefficient investment.

Moreover, plugging the optimal expropriation rate into Equation (10) yields:

$$\Delta_{1s,s^*} = \frac{R}{\phi}\left[\frac{1-\alpha}{\alpha}s^* - \frac{\theta}{2\alpha}s^{*2}\right] = \frac{R(1-\alpha)^2}{2\phi\alpha\theta}. \tag{11}$$

Since $\Delta_{1s,s^*} > 0$, the following is true:

Proposition 2. In the absence of financing constraints, at the optimal expropriation level, the intention of expropriation leads to overinvestment in the pre-expropriation period. The amount of overinvestment decreases with both the controlling shareholder's equity ownership and investors' protection levels.

When expropriation is not at the optimal level, i.e., $s \neq s^*$, Equation (10) shows that the magnitude and direction of the impact of expropriation on investment depend on the expropriation level, controlling shareholder's ownership fraction, and investors' protection level. The inefficient investment as a function of s is plotted in Figure 1. From Figure 1, we see that overinvestment is maximized at $s = s^*$. An increase in s aggravates overinvestment if $s < s^*$, while an increase in s alleviates overinvestment and can lead to underinvestment if $s > s^*$.

Proposition 3. In the case where $s^* > 0.5$, for any expropriation level $s \in (0,1)$, the inefficient investment $\Delta_s > 0$, and the intention of expropriation always causes overinvestment in period 1. In the case where $s^* < 0.5$, if the expropriation level $s \in (0, \tilde{s} = 2s^*)$, then the inefficient investment $\Delta_s > 0$, and the intention of expropriation causes overinvestment. If the expropriation level $s \in (\tilde{s},1)$, then the inefficient investment $\Delta_s < 0$, and expropriation causes underinvestment.

The optimal expropriation level s^* is negatively related to both the investors' protection and the controlling shareholder ownership levels, indicating that better investor protection or high cash flow ownership helps reduce expropriation. If both the investors' protection and controlling shareholder ownership levels are relatively low, s^* can be higher than 0.5. Proposition 3 implies that expropriation always leads to overinvestment in the pre-expropriation period for relatively low investors' protection and controlling shareholder ownership levels. For firms with better investor protection and higher controlling shareholder equity ownership, s^* can be lower than 0.5. In this case, either overinvestment or underinvestment can occur, depending on whether or not the expropriation level exceeds a threshold. Namely, if expropriation is less than the threshold $\tilde{s}$, expropriation causes overinvestment. However, if expropriation exceeds the threshold $\tilde{s}$, expropriation leads to underinvestment.

Note that the threshold level falls as the investor protection level and controlling shareholder equity ownership rise. Thus, Proposition 3 also says that firms with better investor protection and higher controlling shareholder equity ownership are more likely to underinvest in the pre-expropriation period than other firms.

For Chinese listed companies, Jiang et al. (2010) find that the controlling shareholders' average expropriation level can be appropriately measured by other receivables as a percentage

of total assets (ORECTA). We find that the average ORECTA is 0.051 for all firms during our sample period 2003-2013, which is close to the optimal expropriation level according to the law of large numbers. Given that this is far below 0.5, there is a threshold expropriation level in Chinese listed firms above which firms will underinvest. Motivated by short-term benefits, expropriation by controlling shareholders in Chinese listed firms may be well above the optimal expropriation level, leading to underinvestment at the pre-expropriation period.

2.3. Corporate investment and expropriation in the presence of financing constraints

The previous analysis ignores the additional cost of external financing. However, in the real world, it is costly for a firm to raise external funds due to information asymmetry between inside and outside investors. This financing constraint may impact the relation between firm investment and expropriation. In this section, we assume a non-zero external financing cost, i.e., $\varphi_t > 0$, and characterize the relation between inefficient investment and expropriation. For convenience, we analyze the investment decisions in reverse order.

2.3.1. Firm investment in the post-expropriation period

Aslan and Kumar (2012) find that expropriation or tunneling raises firms' cost of debt financing. For this reason, we assume that the post-expropriation cost of financing $\varphi_{3,s}$ is higher than the cost of financing without tunneling φ_3. Based on Equations (1) and (2), the optimal investment levels with tunneling $(I_3/K_3)_{s,f}$ and without tunneling $(I_3/K_3)_f^*$ in period 3 are, respectively, given by:

$$\left(\frac{I_3}{K_3}\right)_{s,f} = \frac{R(\pi + 1 - \delta)}{\phi\left(1 + \varphi_{3,s}\left(\frac{F_3}{K_3}\right)_{s,f}\right)} - \frac{1}{\phi}, \tag{12}$$

$$\left(\frac{I_3}{K_3}\right)^*_f = \frac{R(\pi+1-\delta)}{\phi\left(1+\varphi_3(\frac{F_3}{K_3})^*_f\right)} - \frac{1}{\phi}. \tag{13}$$

Proposition 4. In the presence of financing constraints, expropriation leads to underinvestment in the post-expropriation period, which is given as:

$$\Delta_{3,f} = \left(\frac{I_3}{K_3}\right)_{s,f} - \left(\frac{I_3}{K_3}\right)^*_f \approx -\frac{R\pi(\frac{F_3}{K_3})^*_f}{\phi[1+\varphi_3(\frac{F_3}{K_3})^*_f]^2}(\varphi_{3,s}-\varphi_3). \tag{14}$$

Proposition 4 reveals that firms underinvest in the post-expropriation period due to the fact that expropriation tightens corporate financing constraints. Note that one implicit assumption in Proposition 4 is that tunneling does not affect internally-generated funds in a firm in the post-expropriation period. In fact, tunneling usually reduces the firm's internal funds in the post-expropriation period, boosting the demand for corporate financing, i.e., $(F_3/K_3)_{s,f} > (F_3/K_3)^*_f$. In this case, even if financing costs remain unchanged after tunneling ($\varphi_{3,s} = \varphi_3$), we still have $(I_3/K_3)_{s,f} < (I_3/K_3)^*_f$, and tunneling leads to underinvestment in the post-expropriation period. For example, the controlling shareholder of Jiugui Liquor Co. engaged in tunneling activities in years 2003-2005. As a result, the firm's monetary capital scaled by total assets was particularly low for the following four consecutive years with an average of 0.06, and it gradually increased to 0.15 and 0.43 in 2010 and 2011, respectively.[5]

2.3.2. Corporate investment and expropriation in the expropriation period

Solving Problems (1) and (2) yields the following optimal expropriation fraction, optimal investments with tunneling and without tunneling in period 2:

[5] Sources: CSMAR database.

$$s_f^* = \frac{1-\alpha}{\theta} - \frac{\varphi_2}{\theta}\left(\frac{F_2}{K_2}\right)_{s,f}, \tag{15}$$

$$\left(\frac{I_2}{K_2}\right)_{s,f} = \frac{R[\pi + G_{2s,f} + R(1-\delta)(\pi+1-\delta)]}{\phi\left(1+\varphi_2\left(\frac{F_2}{K_2}\right)_{s,f}\right)} - \frac{1}{\phi}, \tag{16}$$

$$\left(\frac{I_2}{K_2}\right)_f^* = \frac{R[\pi + G_{2f}^* + R(1-\delta)(\pi+1-\delta)]}{\phi\left(1+\varphi_2\left(\frac{F_2}{K_2}\right)_f^*\right)} - \frac{1}{\phi}, \tag{17}$$

where $G_2 = \frac{\phi}{2}[1+\varphi_3(F_3/K_3)](I_3/K_3)^2 + \frac{\varphi_3}{2}(F_3/K_3)^2 + \pi\varphi_3(F_3/K_3)$, representing the reduction in the investment and financing costs in period 3 for one unit increase in investment in period 2.

Taking the partial derivative of $(I_2/K_2)_{s,f}$ with respect to *s* yields:

$$\frac{\partial\left(\frac{I_2}{K_2}\right)_{s,f}}{\partial s} = \frac{R}{\phi\left[1+\varphi_2\left(\frac{F_2}{K_2}\right)_{s,f}\right]}\frac{\partial G_{2s,f}}{\partial s} - \frac{R[\pi + G_{2s,f} + R(1-\delta)(\pi+1-\delta)]}{\phi\left[1+\varphi_2\left(\frac{F_2}{K_2}\right)_{s,f}\right]^2}\frac{\partial\left(\frac{F_2}{K_2}\right)_{s,f}}{\partial s} < 0. \tag{18}$$

Further, using the Taylor's formula, we can obtain the inefficient investment in period 2:

$$\Delta_{2,f} = \left(\frac{I_2}{K_2}\right)_{s,f} - \left(\frac{I_2}{K_2}\right)_f^* \approx \left.\frac{\partial\left(\frac{I_2}{K_2}\right)_{s,f}}{\partial s}\right|_{s=0} \times s < 0. \tag{19}$$

Proposition 5. In the presence of financing constraints, expropriation leads to underinvestment in the expropriation period. In addition, an increase in the expropriation level exacerbates underinvestment.

Intuitively, tunneling by the controlling shareholder decreases the internal funds available for investment, thereby increasing the demand for external corporate financing. This will boost the cost of financing, and thus discourage investment.

2.3.3. Corporate investment and expropriation in the pre-expropriation period

Similarly, the optimal investments in period 1 with and without intention of expropriation are given as:

$$\left(\frac{I_1}{K_1}\right)_{s,f} = \frac{R[\pi + G_{1s,f} + \frac{1-\alpha}{\alpha}s_f - \frac{\theta}{2\alpha}s_f^2] + R^3(1-\delta)^2(\pi+1-\delta)]}{\phi\left(1+\varphi_1(\frac{F_1}{K_1})_{s,f}\right)} - \frac{1}{\phi}, \tag{20}$$

$$\left(\frac{I_1}{K_1}\right)_f^* = \frac{R(\pi + G_{1f}^*) + R^3(1-\delta)^2(\pi+1-\delta)]}{\phi\left(1+\varphi_1(\frac{F_1}{K_1})_f^*\right)} - \frac{1}{\phi}, \tag{21}$$

where $G_1 = \frac{\phi}{2}[1+\varphi_2(F_2/K_2)](I_2/K_2)^2 + \frac{\varphi_2}{2}(F_2/K_2)^2 + \pi\varphi_2(F_2/K_2) + R(1-\delta)G_2$, representing the reduction in investment and financing costs in periods 2 and 3 for one unit increase in investment in period 1.

Based on Equations (20) and (21), the inefficient investment in period 1 is given by:

$$\Delta_{1,f} = \left(\frac{I_1}{K_1}\right)_{s,f} - \left(\frac{I_1}{K_1}\right)_f^* = \frac{R}{\phi[1+\varphi_1(\frac{F_1}{K_1})]}\left[G_{1s,f} - G_{1f}^* + \frac{1-\alpha}{\alpha}s_f - \frac{\theta}{2\alpha}s_f^2\right]$$

$$= \frac{R}{\phi[1+\varphi_1(\frac{F_1}{K_1})]}\left[\left(\frac{\varphi_2\pi^2}{2} - \frac{\theta}{2\alpha}\right)s_f^2 + Ns_f + M\right], \tag{22}$$

where

$$N = \pi\phi\varphi_2\left[\left(\frac{I_2}{K_2}\right)^2_{s,f} - \left(\frac{I_2}{K_2}\right)^{*2}_{f}\right] + \pi\varphi_2\left[\left(\frac{I_2}{K_2}\right)_{s,f} - \left(\frac{I_2}{K_2}\right)^{*}_{f}\right] + \frac{1-\alpha}{\alpha}, \tag{23}$$

$$M = \frac{3\phi^2\varphi}{8}\left[\left(\frac{I_2}{K_2}\right)^4_{s,f} - \left(\frac{I_2}{K_2}\right)^{*4}_{f}\right] + \phi\varphi\left[\left(\frac{I_2}{K_2}\right)^3_{s,f} - \left(\frac{I_2}{K_2}\right)^{*3}_{f}\right]$$

$$+ \frac{\phi+\varphi-2\phi\varphi}{2}\left[\left(\frac{I_2}{K_2}\right)_{s,f} - \left(\frac{I_2}{K_2}\right)^{*}_{f}\right] + G_{2s,f} - G^{*}_{2f}. \tag{24}$$

From Equations (22) to (24), we see that if the expropriation fraction $s_f = 0$, then $M = 0$. On the other hand, if the expropriation level $s_f > 0$, then $M < 0$. We can prove that there exists

$$\varphi_2^{'} = \frac{1-\alpha}{\alpha\pi\varphi\left[\left(\frac{I_2}{K_2}\right)^{*2}_{f} - \left(\frac{I_2}{K_2}\right)^{2}_{s,f}\right] + \alpha\pi\left[\left(\frac{I_2}{K_2}\right)^{*}_{f} - \left(\frac{I_2}{K_2}\right)_{s,f}\right]} \in (0, \frac{\theta}{\alpha\pi^2}),$$

such that $N < 0$ for $\varphi_2 > \varphi_2^{'}$ and $N > 0$ for $\varphi_2 < \varphi_2^{'}$. Thus, we have the following proposition:

Proposition 6. If corporate financing constraints satisfy inequality $\varphi_2 < \varphi_2^{'}$, then there exists an expropriation threshold below which the firm overinvests and above which it underinvests prior to expropriation. If corporate financing constraints satisfy $\varphi_2 > \varphi_2^{'}$, the firm underinvests prior to tunneling for any reasonable expropriation level.

If $\varphi_2 < \varphi_2^{'}$, then both $\varphi_2\pi^2/2 - \theta/(2\alpha) < 0$ and $N > 0$ are true. This suggests that the plot of inefficient investment as a function of the expropriation level is an inverse U-shaped curve. Overinvestment increases with the expropriation level before the optimal expropriation level is reached. Beyond that level, overinvestment will decrease with expropriation, and become underinvestment when the expropriation level is particularly high. If $\varphi_2^{'} < \varphi_2 < \theta/(\alpha\pi^2)$, the firm always underinvests regardless of the expropriation level. If $\varphi_2 > \theta/(\alpha\pi^2)$, then both inequalities

$\varphi_2\pi^2/2-\theta/(2\alpha)>0$ and $N<0$ hold. This suggests that the plot of inefficient investment as a function of the expropriation level is a U-shaped curve. The inefficient investment decreases, reaches its minimum value, and then increases as the expropriation level increases. In this case, the inefficient investment is negative for a reasonable expropriation level, which implies underinvestment.

Proposition 6 says that in the presence of corporate financing constraints, the threshold effect becomes less pronounced as financing constraints tighten: firms facing a particularly tight financing constraint tend to underinvest prior to tunneling.

Our model provides a number of testable predictions with respect to the relationship between inefficient investment and expropriation for firms with different financing constraints. Note that, in reality, financing constraints are present in all firms, though the tightness of financing constraints varies across firms. To summarize, the following testable hypothesis are derived from our model:

H1. For companies with less tight financing constraints, expropriation leads to overinvestment in the pre-expropriation period if the intended expropriation level is lower than a threshold, while it leads to underinvestment if the intended expropriation level is greater than the threshold.

H2. For companies with tight financing constraints, expropriation leads to underinvestment in the pre-expropriation period, regardless of the severity of expropriation.

H3. For companies with financing constraints, expropriation leads to underinvestment in both the expropriation and post-expropriation periods, and this effect becomes more pronounced as the tightness of financing constraints increases.

In the remainder of this article, we will empirically test these hypotheses using data on Chinese listed companies. To this end, we focus on tunneling activities such as outright theft, connected transactions, connected loans, and transfer pricing based on the CSRC and exchange administrative sanction decisions. We define the expropriate period as the year in which tunneling activities are conducted, while pre- and post-expropriate periods are one year prior to and the first two years after the expropriation year, respectively.[6] Importantly, we will also examine how inefficient investment changes after the administrative sanctions against firms or their executives for tunneling activities are imposed and announced to the public.

3. Research methodology

3.1. Measuring inefficient investment

Following Richardson (2006), we decompose a firm's net investment into its expected investment and inefficient investment, where the former is determined by the firm's growth opportunities and financing constraints. To estimate inefficient investment, we run the following regression:

$$I_{i,t} = \beta_0 + \beta_1 Growth_{i,t-1} + \beta_2 Lev_{i,t-1} + \beta_3 Cash_{i,t-1} + \beta_4 Age_{i,t-1} + \beta_5 Size_{i,t-1} + \beta_6 AR_{i,t-1} + \beta_7 I_{i,t-1} + \sum_t \lambda_t YEAR_{i,t-1} + \sum_k \gamma_k INDUSTRY^k_{i,t-1} + \varepsilon_{i,t}, \quad (25)$$

where the explained variable $I_{i,t}$ is the new investment level in firm i in year t as a percentage of year-end assets. The major explanatory variable in the regression is $Growth_{i,t\text{-}1}$, which is Tobin's Q for firm i in year $t-1$ as a measure of investment opportunities. The control variables include $Lev_{i,t\text{-}1}$, $Cash_{i,t\text{-}1}$, $Age_{i,t\text{-}1}$, $Size_{i,t\text{-}1}$, $AR_{i,t\text{-}1}$, and $I_{i,t\text{-}1}$, which are the firm's financial leverage measured by the ratio of total assets to total liabilities, cash balance scaled by total assets, firm

[6] Our empirical results show that the impact of tunneling on investment prior to the tunneling year is generally less than 2 years, and the impact after the tunneling year is generally less than 3 years. Figure 2 also shows that firm inefficient investment, size, debt and equity financing, free cash flow, and earnings per share vary greatly within this time period.

age defined as the logarithm of the number of years since the firm was founded, firm size measured by the logarithm of total assets, stock return, and total investment in the past year, respectively. These control variables are present to control for firm characteristics that impact expected investment. In addition, dummy variables *YEAR* and *INDUSTRY* are included to control for the time and industry effects, respectively.

The fitted value from the regression represents the estimate of the expected new investment for a firm in a particular year, and the residual is the estimate of inefficient investment (II). A positive residual corresponds to overinvestment (OI), while a negative residual is associated with underinvestment (UI).

3.2. Measuring the severity of tunneling

Our model shows that the expropriation level plays an important role in explaining whether firms overinvest or underinvest in different periods. To examine this issue, we differentiate severe tunneling from non-severe tunneling practices, based on the average ORECTA in listed firms. ORECTA reflects the size of non-operating financial transactions between a company and its controlling shareholder in a given year, and can be used to measure the severity of tunneling (Jiang et al., 2010). In this paper, we first examine whether ORECTA observations fit the normal distribution using the quantile-quantile normality test, and then identify those extreme values with a confidence level higher than 95% for firms with reported tunneling practices.[7] These observations are considered to be associated with severe tunneling activities. We understand that some tunneling practices may not be reflected in firms' ORECTAs. Thus, we also use the type of sanctions imposed by the CSRC to determine whether a tunneling activity is severe. In China, companies or their top executives that have committed tunneling activities could be given a

[7] This is consistent with the criterion used by large financial institutions such as Morgan Stanley to measure extreme events in risk management. The same criterion is also applied to the classification of the tightness of financing constraints.

warning, imposed a penalty fine, given a circulated criticism, ordered to correct violations of laws and regulations, or issued a public denouncement by the CSRC once their illegal conduct has been investigated and confirmed. Of all these punishments, public denouncement represents the most severe administrative sanction decision, often issued when illegal practices are judged to be serious, based on the facts, nature and condition of, and the harmful effects caused by the illegal conduct.

3.3. Measuring the tightness of financing constraints

Our model predicts that the way in which inefficient investment is related to tunneling depends greatly on the tightness of a firm's financing constraints. To test our hypotheses, we classify firms as having either less tight or tight financing constraints, based on their banking credit constraints. We focus on banking credit constraints, as bank loans are a major source of external funds for Chinese listed companies (Cai et al., 2005; Li and Yu, 2009). Further, the measures such as dividend payout, debt rating, commercial paper rating, and Kaplan-Zingales Index used in previous studies (Almeida et al., 2004; Fazzari et al., 1988; Kaplan and Zinglales, 1997; Whited, 1992) cannot accurately measure the financing constraints faced by Chinese listed companies. This is because the dividend policies of Chinese listed firms are largely affected by economic policies. In addition, data on debt credit quality ratings are not readily available due to the fact that the Chinese bond markets are underdeveloped and the credit quality ranking mechanism in China is not well established (Wei and Liu, 2004; Wang, 2009)

During the period in which China's bank financing system transitioned from a centrally-planned to a market-oriented system, the Chinese state-owned banks made lending decisions based not only on a firm's profitability and capability of generating cash flows, but also on political considerations. On one hand, as a result of market-oriented banking system reforms,

Chinese state-owned banks now have strong incentives to maximize profitability while controlling risk exposure, and thus are more willing to make loans to firms with high free cash flows, well-known loan guarantors, and high value collaterals. On the other hand, the Chinese banking system remains under control of governments, and is used to promote economic growth and help implement the government's economic policies. Given the particularly important role that large SOEs play in the Chinese economy, Chinese banks are expected to support SOEs with soft loans and other financial supports. Chinese SOEs are typically granted the privilege of obtaining bank loans and other sources of financing at a low cost. Therefore, to determine whether or not a firm faces tight financing constraints, we consider the following variables: net operating cash flows, loan guarantors, total pledgeable assets, firm size, and whether the firm is a SOE.

Firms with less tight financing constraints include those that are large SOEs, as well as those with high net operating cash flows, better loan guarantors, and high value pledgeable assets. More specifically, we first sort all listed companies in our sample based on firm size and define the top 19.1% of the firms that are under government control as firms with less tight financing constraints.[8] Meanwhile, the following firms are also considered to be the firms with less tight financing constraints: those whose net operating cash flows or net fixed assets are among the top 5% of all listed firms, or those that have central SOEs (SOEs under the supervision and administration of the State-owned Assets Supervision and Administration Commission (SASAC)

[8] Given that the golden ratio 0.618 represents beauty, harmony, and balance in physical form, we use the golden ratio to classify firms into different groups based on firm size. Namely, observations on firm asset values with confidence levels [0, 0.191), [0.191, 0.809], and (0.809, 1] are defined as small, medium, and large size firms, respectively.

of the State Council) or large SOEs as their related parties.[9] The rest of the firms are considered to be firms with tight financing constraints.

3.4. Empirical models

In this paper we adopt the difference-in-differences (DID) method (Ashenfelter and Card, 1985) to assess the impact of tunneling by controlling shareholders on corporate investment decisions. The DID method classifies the sample into a treatment group and a control group, where the former consists of firms that engage in tunneling practices in period 2, and the latter consists of firms without tunneling practices. Then, the difference in investment between the two groups in each period is estimated and used to gauge the tunneling effect. Compared with the event study method, this approach can isolate the tunneling effect from the impacts of other factors that changed in the expropriation period.

3.4.1. Construction of the treatment and control groups

To obtain an unbiased estimate of the expropriation effects, the treatment and control groups should be carefully constructed such that they are similar in terms of the observables other than the impact of tunneling. More specifically, we select companies for the treatment and control groups in order to ensure that both groups are similar in size, industry, and ownership structure, among others apart from tunneling, and then compare their investment decisions. To this end, we adopt the propensity score matching (PSM) method (Rosenbaum and Rubin, 1983), which pairs treatment and control groups with similar values on the propensity score (PS) to correct for sample selection biases due to observable differences between the two groups. The following

[9] A related party is a legal entity or an individual who directly or indirectly controls the firm. We focus on related parties, as the primary loan guarantors for a Chinese firm are the firm's related parties. We particularly focus on those that have related party transactions with their firms for at least 5 years and those with an averaged related party transaction value to total assets ratio higher than the overall average.

describes the steps for constructing the treatment and control groups based on the PSM matching procedure:

First, we identify the firms that have never engaged in tunneling activities, namely the control firms. Given the illicit nature of tunneling, the controlling shareholders tend to cover up tunneling practices to avoid being detected and punished by regulatory authorities and exchanges. Thus, it is important to ensure that all the companies in the control group are truly those without tunneling rather than those whose tunneling activities have not yet been revealed. In our paper a company is classified as a "control" company if: 1) it has never been punished by the CSRC; 2) it has never received any audit suggestions other than "with no reservation" in auditors' reports; 3) it has never received a special treatment designation (ST) from CSRC;[10] 4) it has never been involved in large non-operating fund transactions with its related parties. Precisely, the ORECTA has never been higher than the 61.8th percentile of all listed companies.[11]

Second, we estimate all firms' PSs. Following Deheji and Wahba (2002), we estimate a firm's PS using the Logit model as below:

$$\ln\left(\frac{P(Vio_{i,t}=1\,|\,Inf_{i,t})}{1-P(Vio_{i,t}=1\,|\,Inf_{i,t})}\right)=\alpha_0+\sum_j\alpha_j Inf_{i,t}^{j}+\sum_t\lambda_t YEAR_{i,t}+\sum_k\gamma_k INDUSTRY_{i,t}^{k}+\varepsilon_{i,t}, \quad (26)$$

where $Vio_{i,t}$ is a dummy variable that equals 1 if firm i conducted tunneling activities in year t, and equals 0 otherwise. $Inf_{i,t}^{j}$ represents the jth factor that influences tunneling for firm i in year t. In this paper, following Zhang and Shi (2013) and Shi (2012), we consider the following three types of factors. We consider factors that affect the opportunity cost of tunneling, including the proportion of total shares held by major shareholders ($Top1$) and the firm's growth opportunities

[10] Gao and Song (2007) and Gao and Zhang (2009) find that the companies that have received audit suggestions other than "with no reservation" in auditor's reports and those that have received a special treatment designation (ST) from CSRC are more likely to engage in tunneling practices.
[11] The golden ratio is used to classify firms into high and low ORECTA firms. See Footnote 8 for explanation.

measured by Tobin's Q (*Q*). Next, we consider factors that affect investor protection level, including the degree of separation between control rights and cash flow rights (*Sep*), the degree of equity ownership concentration (*Her*), the proportion of outstanding shares of stock held by institutional investors (*Ins*), the separation of CEO role from Board chair role (*Dep*), board size (*Board*), the proportion of outside independent directors on the board of directors (*Indp*), agency costs arising from conflicts of interest between the controlling shareholder and top executives (*AC*), the proportion of total shares held by corporate executives (*Gshare*), degree of leverage (*Lev*), whether firm *i* is audited by the Big Four accounting firms (*Adu*),[12] whether the firm has H-shares listed on the Hong Kong Stock Exchange (*Ph*), and whether the time of observation is after January 1, 2006 on which date the new Company Law of the People's Republic of China became effective (*Law*). Finally, we consider factors that affect financing constraints, including whether the firm is a large SOE or has central SOEs as loan guarantors (*Gua*), whether the firm is a SOE (*Sta*), operating cash flows (*Cf*), value of fixed assets (*Fix*), and firm size (*Size*). Table 1 summarizes these variables and their definitions. To control for the possible non-linear effects of agency costs and degree of leverage on tunneling, we include AC^2 and Lev^2. Given that the impact of corporate governance on controlling shareholder tunneling may vary after the new Company Law became effective on January 1, 2006, we also include cross-product terms *Ins*×*Law*, *Her*×*Law*, *Dep*×*Law*, *Board*×*Law*, *Indp*×*Law*, and *Gshare*×*Law*. Based on the regression results, we can obtain the expected probability of tunneling by the controlling shareholder in a firm, which is the estimate of the firm's PS.

Third, we pair treated firms (firms with tunneling activities) and control firms (firms without tunneling activities). Propensity score matching entails forming matched groups of treated and control firms who share a similar value of the propensity score (Rosenbaum and Rubin, 1983).

[12] The world's four largest accounting firms include Deloitte, PwC, Ernst & Young, and KPMG.

Our empirical analysis shows that the time period for the controlling shareholder's preparation for tunneling is typically less than 2 years, and the impact of tunneling on firm investment lasts less than 3 years. Thus, we match treated and control companies in terms of their propensity scores achieved 2 years prior to the tunneling year, using the nearest neighbor matching method.[13] We also use the radius matching and kernel matching algorithms to test the robustness of our results in this paper.

Finally, we compare the means of the explanatory variables for treated and control firms within each subclass, and find that the differences are not significant. This indicates that our selection method has taken into account the endogeneity of tunneling due to observables.

3.4.2. Test of endogeneity due to unobserved variables

While the PSM method addresses the endogenous problem due to observables, endogeneity can occur if some unobserved variables that influence firm inefficient investment also influence tunneling. If such unobserved variables exist, then the DID estimate of tunneling effect on inefficient investment may not be consistent. To test this potential endogenous problem, we use a Logit model to test whether firms' inefficient investment (*II*) and the lagged inefficient investment (*L_II*) affect tunneling activities by control shareholders. Intuitively, if some unobservable variables that are associated with inefficient investment influence tunneling, then the coefficients on both *II* and *L_II* will be significant. If otherwise, these coefficients are insignificant. This Logit model is as follows:

$$\ln\left(\frac{P(Vio_{i,t}=1\,|\,Inf_{i,t})}{1-P(Vio_{i,t}=1\,|\,Inf_{i,t})}\right)=\alpha_0+\beta_1 II_{i,t}+\beta_2 L\_II_{i,t}+\sum_j \eta_j Control_j$$
$$+\sum_t \lambda_t YEAR_{i,t-1}+\sum_k \gamma_k INDUSTRY_k+\varepsilon_{i,t}. \qquad (27)$$

[13] We primarily use 2 years prior to expropriation as the base period in this exercise. For this purpose, we also use data from 2000 to 2002 to ensure that our sample is for the period from 2003 to 2013.

where $II_{i,t}$ is inefficient investment firm i in year t, which is the difference between firm i's net investment in year t and the industry average net investment, and $L\_II_{i,t}$ is one-year lagged $II_{i,t}$. $Control_j$ represent the control variables, which are the factors that affect inefficient investment considered in Equation (26).

3.4.3. Inefficient investment and tunneling

To detect the impact of tunneling by the controlling shareholder on a firm's dynamic investment decisions, we run the following regression

$$\begin{aligned} II_{i,t} = {} & \beta_0 + \beta_1 Nbe_{i,t} + \beta_2 Sbe_{i,t} + \beta_3 Nmid_{i,t} + \beta_4 Smid_{i,t} + \beta_5 Naf_{i,t} + \beta_6 Saf_{i,t} \\ & + \delta_1 Nbe_{i,t} \times x_{i,t} + \delta_2 Sbe_{i,t} \times x_{i,t} + \delta_3 Nmid_{i,t} \times x_{i,t} + \delta_4 Smid_{i,t} \times x_{i,t} \\ & + \delta_5 Naf_{i,t} \times x_{i,t} + \delta_6 Saf_{i,t} \times x_{i,t} + \beta_7 x_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{28}$$

where $II_{i,t}$ represents inefficient investment (over- or underinvestment) for firm i in year t estimated from Equation (25). $x_{i,t}$ is a dummy variable taking the value 1 if firm i is in the treatment group, and 0 if the firm is in the control group. *Nbe*, *Nmid*, and *Naf* are dummy variables for the pre-expropriation, expropriation, post-expropriation periods, respectively, if a tunneling activity is considered not severe, while *Sbe*, *Smid*, and *Saf* are dummy variables for the pre-expropriation, expropriation, and post-expropriation periods, respectively, if a tunneling activity is considered severe. No control variables are included in this model, as the relevant effects are controlled when treated and control firms are matched. To test the robustness of the results, we control for the average industry inefficient investment, time, and industry effects, and run the following regression:

$$\begin{aligned} II_{i,t} = {} & \beta_0 + \beta_1 Nbe_{i,t} + \beta_2 Sbe_{i,t} + \beta_3 Nmid_{i,t} + \beta_4 Smid_{i,t} + \beta_5 Naf_{i,t} + \beta_6 Saf_{i,t} \\ & + \delta_1 Nbe_{i,t} \times x_{i,t} + \delta_2 Sbe_{i,t} \times x_{i,t} + \delta_3 Nmid_{i,t} \times x_{i,t} + \delta_4 Smid_{i,t} \times x_{i,t} \end{aligned}$$

$$+\delta_5 Naf_{i,t}\times x_{i,t}+\delta_6 Saf_{i,t}\times x_{i,t}+\beta_7 x_{i,t}$$

$$+\beta_8 AII_{i,t}+\sum_t \lambda_t YEAR_{i,t}+\sum_k \gamma_k INDUSTRY_{i,t}^k+\varepsilon_{i,t}, \quad (29)$$

where $AII_{i,t}$ represents the average inefficient investment for firm *i*'s industry in year *t*. *YEAR* and *INDUSTRY* are the dummy variables aiming for controlling for the time and industry effects, respectively.

Our interest is in the coefficients δ_m ($m=1,2,\cdots,6$) on the cross-product terms, which reflect the impact of tunneling on inefficient investment in various periods. A significant and positive estimated δ suggests that tunneling aggravates overinvestment or alleviates underinvestment, while a significant and negative estimated δ suggests that tunneling alleviates overinvestment or aggravates underinvestment during a particular period. More specifically, the estimated δ_1 and δ_2 measure the impacts of non-severe and severe tunneling on pre-expropriation inefficient investment, respectively. If Hypothesis 1 is true, then δ_1 is significantly positive and δ_2 is significantly negative, when the data on companies with less tight financing constraints is used in the estimation. If Hypothesis 2 is true, then both δ_1 and δ_2 are significantly negative for companies with tight financing constraints. Similarly, if Hypothesis 3 is true, then the estimated δ_3, δ_4, δ_5, and δ_6 are all significantly negative for firms with financing constraints.

4. Data

Our sample period extends from January 2003 to December 2013. We start with all A-share companies listed on the Shanghai and Shenzhen Stock Exchanges, which are the only two stock exchanges in China. We exclude companies in the financial sector, companies with a post-IPO period less than two years, as well as companies with missing or irregular data in our sample

period. To prevent extreme observations from influencing our results, all of our variables are winsorized at the 1st and 99th percentiles (Flannery and Rangan, 2006). We end up with a total of 432 companies with 4406 observations. All financial data for these companies is obtained from the CSMAR database, whereas the data on tunneling is manually collected from the CSMAR and wind databases as well as from companies' rectification reports.

Table 2 reports the results of Regression (25), which show that firms' expected investment are significantly positively related to firm growth opportunities, one-period lagged returns, cash balance, firm size, and investments, but are significantly negatively related to firm financial leverage and age. This finding is consistent with those in the previous studies on Chinese listed companies (Du et al., 2011; Jiang et al., 2009; Wei and Liu, 2007; Xin et al., 2007). The residuals are obtained accordingly, which are the estimates of inefficient investment.

Table 3 presents the descriptive statistics of inefficient investment and various major variables considered in our model for companies with different financing constraints. We find that while the average inefficient investment is negative for all companies and for companies with tight financing constraints, it is positive for companies with less tight financing constraints. In addition, companies with less tight financing constraints typically have a lower Tobin's Q, stock return, degree of separation of the CEO role from board chair role, and proportion of shares held by corporate executives than companies with tight financing constraints, but have a higher value of all other variables.

Panel A of Table 4 reports the descriptive statistics of inefficient investments for companies with tunneling practices in pre-expropriation, expropriation, and post-expropriation periods, while Panel B reports the descriptive statistics for companies without tunneling practices in the corresponding periods. We note that all firms, on average, overinvest in the pre-expropriation

period, but firms with tunneling activities overinvest more. In the expropriation and post-expropriation periods, treated firms underinvest while control firms tend to overinvest. Moreover, treated firms underinvest the most after the sanctions on firms for tunneling are imposed and released to the public. Control firms' overinvestment is more pronounced after the tunneling year. This observation suggests that tunneling leads to overinvestment in the pre-expropriation period, while it reduces investment and can lead to underinvestment in the expropriation and post-expropriation periods.

Figure 2 displays firms' new investment, size, financing, free cash flow, and earnings per share (EPS) for companies with tunneling during various years before and after expropriation. Given the relatively small number of observations on firms with less tight financing constraints and severe tunneling activities, in this figure we focus only on those with tight financing constraints and with non-severe tunneling activities. From this figure, we see that the average new investment levels in the years prior to expropriation are all positive, and the average new investment one year before expropriation is particularly higher than the average for the years with no tunneling activities. However, the inefficient investments in the years prior to expropriation are lower than the average for years other than the years considered in the figure. This indicates that in the pre-expropriation period, while firms are prone to increase investment, the average investment is lower than the optimal level. We also note that in the expropriation year and years after expropriation, the averaged new investment level and inefficient investment level are negative. In particular, in the first and second years after tunneling and in the first year after the sanctions on firms for tunneling are imposed, the average new investment level is much lower than the corresponding levels for the years with no tunneling activities. This demonstrates that tunneling reduces investment in both expropriation and post-expropriation periods for these

firms. This effect is especially pronounced in first year and second year after tunneling, as well as in the year when sanctions are imposed and in the first year after sanctions are imposed.

This figure also indicates that in the pre-expropriation period, the average firm size and the average sizes of both equity and debt financing are close to or higher than the averages for the years other than the years before and after tunneling, but they decline dramatically in the expropriation and post-expropriation periods. A similar pattern is also observed for free cash flow and earnings per share in these firms. This suggests that tunneling tightens the financing constraints and reduces the size of firm financing and investment, leading to a lower firm value.

5. Empirical results

5.1. Inefficient investment and expropriation

Table 5 reports the estimation results of Equation (27). Model 1 includes *II* as an explanatory variable, whereas Model 2 includes both *II* and *L_II*. The estimated coefficients on *II* and *L_II* in both models are not significant, indicating that inefficient investment does not significantly impact controlling shareholder expropriation decisions. This confirms that there are no other factors that influence both firm inefficient investment and or tunneling after controlling for the effect of observables, and that the DID method can be used in our analysis.

Table 6 reports the results of Equations (28) and (29). We note that for firms with less tight financing constraints, the estimated coefficient on $Nbe \times x$ is positive and significant at the 1% level, whereas the coefficient on $Sbe \times x$ is negative and significant at the 5% level, regardless of whether the average industry inefficient investment is controlled in the regression. This result indicates that these firms overinvest in the pre-expropriation period if controlling shareholders intend to engage in non-severe tunneling activities at a later date, but underinvest if controlling shareholders intend to engage in severe tunneling activities. This finding is consistent with the

model prediction, and provides evidence in favor of Hypothesis 1. Intuitively, firms' controlling shareholders have incentives to increase investment today in order to better expropriate minority shareholders in the future if the intended expropriation level is not too high. On the other hand, if the expropriation level is high, then the costs of expropriation are particularly higher than the benefits from expropriation for an additional increase in investment, and thus, these firms underinvest in order to reduce the costs of expropriation in the expropriation period.

However, the insignificance of the estimated coefficients on both $Nbe \times x$ and $Sbe \times x$ for firms with tight financing constraints does not seem to support Hypothesis 2. One possible reason for this result is that most listed firms in China are large SOEs that are capable of obtaining external financing and government support. Thus, most Chinese firms do not face particularly tight financing constraints, even if they are classified as firm with tight financing constraints in our exercise. Given that these firms face relatively tight financing constraints compared with others, the results imply that the threshold effects diminish as the financing constraints become tighter.

For firms with less tight financing constraints, the estimated coefficients on the cross-product terms are not significant in the expropriation and post-expropriation periods. This suggests that for firms with less tight financing constraints, inefficient investment remains unchanged in the expropriation and post-expropriation periods regardless of whether or not tunneling is severe. For firms with tight financing constraints, however, the estimated results show that investment is reduced in the expropriation period if the tunneling activity is not severe. If it is severe, the estimated coefficient is negative but not significant. One possible reason for this result is that some of the severe tunneling practices are conducted during the investment period, which means that these severe tunneling activities are actually associated with increases in investment, although other severe tunneling activities reduce investment. In the post-expropriation period,

the estimated coefficients on the cross-product terms are significantly negative, irrespective of whether or not tunneling is severe. Thus, tunneling leads to underinvestment in the post-expropriation period, and this effect is particularly pronounced in terms of the size of the coefficient if tunneling is severe. This is because tunneling exacerbates external financing constraints for firms that already face tight financing constraints. This provides compelling evidence in favor of Hypothesis 3 that links inefficient investment and tunneling in the expropriation and post-expropriation periods.

5.2. Overinvestment/underinvestment and expropriation

A firm's inefficient investment may be primarily due to overinvestment or underinvestment. In this section, we classify inefficient investment into overinvestment and underinvestment, and examine how the impact of tunneling on overinvestment differs from the impact on underinvestment.

Panel A of Table 7 reports the estimation results of Equation (28) when the explained variable is overinvestment or underinvestment, while Panel B reports the results of Equation (29). Focusing on firms with less tight financing constraints, we find that the coefficient on $Nbe \times x$ is positive and significant, while the coefficient on $Sbe \times x$ is insignificant if the explained variable is overinvestment. This suggests that firms with overinvestment will overinvest more if controlling shareholders intend to divert a relatively small percentage of output to themselves next year, but overinvestment remains unchanged if the intended expropriation fraction is high. Regarding firms with underinvestment, these underinvest less prior to expropriation if the intended expropriation level is not high, but underinvest more if the intended expropriation level is high. This implies that if a firm underinvests, less severe tunneling alleviates the underinvestment problem, while severe expropriation exacerbates underinvestment. The

coefficients on *Nmid*×*x*, *Smid*×*x*, *Naf*×*x*, and *Saf*×*x* are generally insignificant for firms with less tight financing constraints. This suggests that in the expropriation and post-expropriation periods, firms with less tight financing constraints continue their overinvestment or underinvestment as before.

For firms with tight financing constraints, our results indicate that controlling shareholders' intention to expropriate at a later date generally does not affect overinvestment, but may reduce underinvestment if the intended expropriation level is high. However, in the expropriation and post-expropriation periods, these firms typically overinvest less or underinvest more, particularly in the case of severe tunneling. This confirms that tunneling further tightens these firms' financing constraints, leading to particularly low investment compared with the expected investment level.

5.3. Inefficient investment after sanctions on firms for tunneling are imposed

The previous analysis focuses on the relation between inefficient investment and tunneling without considering other potential consequences of tunneling. Once a firm's tunneling practice is investigated and confirmed, the CSRC will impose sanctions on the firm and its top executives, and top management may be replaced. Thus, once the sanction decision on tunneling is released to the public, the firm's reputation could be seriously harmed and its cost of capital could be greatly enhanced. To investigate how inefficient investment responds to the news that a firm is punished for its tunneling practices, we consider the following regression model:

$$\begin{aligned} II_{i,t} = {} & \beta_0 + \beta_1 Nbe_{i,t} + \beta_2 Sbe_{i,t} + \beta_3 Nmid_{i,t} + \beta_4 Smid_{i,t} + \beta_5 Naf_{i,t} + \beta_6 Saf_{i,t} \\ & + \beta_7 Npun_{i,t} + \beta_8 Spun_{i,t} + \delta_1 Nbe_{i,t} \times x_{i,t} + \delta_2 Sbe_{i,t} \times x_{i,t} + \delta_3 Nmid_{i,t} \times x_{i,t} \\ & + \delta_4 Smid_{i,t} \times x_{i,t} + \delta_5 Naf_{i,t} \times x_{i,t} + \delta_6 Saf_{i,t} \times x_{i,t} + \delta_7 Npun_{i,t} \times x_{i,t} \\ & + \delta_8 Spun_{i,t} \times x_{i,t} + \beta_9 x_{i,t} + \varepsilon_{i,t}, \end{aligned} \tag{30}$$

where *Npun* is a dummy variable that equals 1 in the year in which, or one year after, the administrative sanctions on firms are imposed and are announced to the public for non-severe tunneling practices, and 0 otherwise, while *Spun* is a dummy variable that is defined in a similar fashion for severe tunneling activities. Other variables are the same as those in Equations (28).

Table 8 reports the estimation results for Equation (30). Our results also show that for firms with less tight financing constraints the announcement of sanction decisions generally does not impact inefficient investment unless the firms overinvest and tunneling is severe.[14] While the announcement of sanction decisions may boost a firm's cost of external financing and reduce investment, firms with less tight financing constraints do not have to cut investment.

For firms with tight financing constraints, the estimated coefficients on $Npun \times x$ and $Spun \times x$ are negative and significant when the explained variable is inefficient investment, indicating that the announcement of sanction decisions reduces firms' investment, and this effect is more pronounced for severe tunneling activities in terms of the size and significance of these estimated coefficients. This is also true when the explained variable is overinvestment. However, when firms underinvest, if tunneling is severe, the announcement of sanction decisions further exacerbates the underinvestment problem, while it does not affect their investment behavior if tunneling is not severe.

6. Robustness tests

6.1. Results based on firms with tunneling practices

Our empirical results are obtained using the DID method by examining the difference in inefficient investment between treated and control firms. In this section, we focus on treated

[14] The estimated coefficient on $Npun \times x$ is also significant at the 10% level if the explained variable is inefficient investment.

firms only, and examine how inefficient investment is associated with tunneling during various periods based on this restricted sample. To this end, we run the following regression:

$$II_{i,t} = \beta_0 + \beta_1 Nbe_{i,t} + \beta_2 Sbe_{i,t} + \beta_3 Nmid_{i,t} + \beta_4 Smid_{i,t} + \beta_5 Naf_{i,t} + \beta_6 Saf_{i,t} + \beta_7 Npun_{i,t}$$
$$+ \beta_8 Spun_{i,t} + \sum_j \eta_j Control_j + \sum_t \lambda_t YEAR_{i,t} + \sum_k \gamma_k INDUSTRY_{i,t}^k + \varepsilon_{i,t}, \quad (31)$$

where $Control_j$ are the control variables aiming at controlling for other effects on inefficient investment. We include the following five control variables in the regression. The first is the variable *Her*, measuring the degree of equity ownership concentration. Corporate ownership concentration is negatively related to investor protection (Claessens et al., 2000; La Porta et al., 2002), which impacts the cost of expropriation. The second control variable is *Gshare*, measuring the proportion of shares held by corporate executives. A high proportion of shares held by executives will help better align the interests of the controlling shareholder with the interests of other shareholders, reducing the controlling shareholder's incentives of expropriation. Both variables can be used as proxies for the quality of shareholder protection, which is the key factor in our model that explains how inefficient investment is related to tunneling.

The third variable is the firm's profitability, measured by its return on assets *ROA*. Intuitively, a more profitable firm faces less tight financing constraints, as it is better able to generate internal funds for financing investment. Finally, we also control for the effects of other factors on inefficient investment. One is the agency cost (*AC*) arising from the conflicts of interest between managers and shareholders in listed firms. Jensen (1986) and Fazzari et al. (1988) find that agency conflicts are a major factor that causes inefficient investment. Following Ang et al. (2000), we use the ratio of administrative expenses to annual sales as a measure of agency costs in the model. Additionally, in China, SOEs typically have stronger political connections with government officials than are non-SOEs. Thus, SOEs are more likely to obtain

tax reliefs and fiscal subsidies from governments than non-SOEs, and are expected to help achieve some non-economic goals, such as boosting local employment. To control for the possible distinct investment behaviors between SOEs and non-SOEs, we include in our model a dummy variable *Sta*, which equals 1 if the company under consideration is a SOE, and 0 otherwise.

Table 9 reports the estimation results of Equation (31). The results in Panel A are in line with the results in Tables 6 and 8, confirming our major findings about inefficient investment in various periods. In particular, for firms with less tight financing constraints, overinvestment prior to tunneling is associated with the intention of non-severe tunneling, while underinvestment corresponds to the intention of severe tunneling. Tunneling does not lead to a significant change in inefficient investment in the expropriation and post-expropriation periods for firms with less tight financing constraints. Our results also show that the estimated coefficients on *Npun* and *Spun* are now negative and significant at the 10% level, indicating that tunneling leads to a reduction in inefficient investment. For firms with tight financing constraints, the investment behavior generally remains unchanged in the pre-expropriation period even though the estimated coefficient on *Sbe* is negatively significant at the 10% level. However, investment is significantly reduced in the post-expropriation period and in the years after the sanction decisions are announced.

The results in Panel B indicate that firms with less tight financing constraints overinvest more or underinvest less prior to tunneling as long as the intended expropriation level is not high, and underinvest more if the intended expropriation level is particularly high. The results also show that tunneling does not impact inefficient investment in the expropriation and post-expropriation periods and after the sanction decisions are published, regardless of whether it is

overinvestment or underinvestment. For firms with tight financing, the intention of tunneling does not change the investment behavior in the pre-expropriation period, but investment is generally reduced after expropriation and after the sanction decisions are announced. Overall, the results obtained based on the restricted sample of treated firms are similar to the findings based on the DID method.

6.2. Measurement errors in inefficient investment and tightness of financing constraints

When we estimate inefficient investment using Richardson's (2006) model, we use Tobin's Q as a proxy for investment opportunities. Since the Chinese stock market is less efficient than developed markets and holdings of Chinese SOEs are divided into non-tradable government shares and tradable private shares, Tobin's Q may be a poor measure of investment opportunities for Chinese firms. To gauge whether this measure biases our results, following Wang (2006) and Wang (2009), we use sales growth as an alternative measure of investment opportunities. Using this alternative measure, inefficient investment is re-estimated, and Regression (28) is re-run to see whether the results are robust with this change in specification.

The estimation results if the explanatory variable is inefficient investment are reported in Panel A of Table 10. The results are similar to the results in Table 6. Panel B of Table 10 reports the estimation results of Regression (28) when the explanatory variable is either underinvestment or overinvestment. The results are in general consistent with those in Table 7.

Our results may depend on how the tightness of financing constraints for a firm is measured. To examine this issue, we reclassify firms with less tight and tight financing constraints based solely on firm size, since Hennessy and Whited (2007) find that the tightness of firms' financing constraints can be measured by firm size. Most large Chinese firms are SOEs that operate in particularly profitable industries, and thus have better performance than small firms. Moreover,

large firms typically have stronger political connections with governments, and have more access to external financing. Small firms are typically subject to stricter financing constraints, with fewer sources of financing available compared with large firms. Thus, we sort all firms based on firm size and define those in the top 20% as firms with less tight financing constraints, and the rest are firms with tight financing constraints. Based on this classification, we re-run Regressions (28) to (30), and report the results in Table 11.

The results in Panel A are similar to those in Table 6. The results in Panel B are slightly different from the results in Table 7. For example, for firms with less tight financing constraints and underinvestment, while the estimated coefficient on $Nbe \times x$ is still positive, it is not significant. In addition, the results show that investment is reduced in the post-expropriation period if the expropriation level is high. Nevertheless, the main results remain the same as what we obtained in the previous analysis.

6.3. Possible biases in matching treated and control firms

Another possible bias in our analysis may come from the method used to match treated and control companies. In the previous analysis, we match treated and control companies based on their propensity scores achieved 2 years prior to the tunneling year, using the nearest neighbor matching method. In this section, we use the kernel matching method based on the propensity scores achieved 3 years prior to the tunneling year to examine the robustness of our results. The results are reported in Table 12. These results are similar to those reported in Tables 6, 7, and 8, indicating that our findings are robust even if we use a different method to match treated and control companies.

We also re-run the Regressions (28) and (30) using the OLS, assuming that there is no fixed effect. While the results are not reported here, to save space, the results again generally confirm our previous findings.

7. Conclusions

This paper presents a dynamic model that describes the relation between investment and expropriation by controlling shareholders for firms facing different financing constraints. We show that expropriation can impact firm investment not only in and after the expropriation period, but also before the expropriation period. In particular, our model shows that a firm overinvests if it intends to engage in expropriation activities in the future and if the expropriation level is not too high. However, the firm underinvests if it intends to tunnel a large proportion of total output in the future. Our model further predicts that expropriation does not impact firm investment in and after the expropriation period if the firm faces no financing constraints, but expropriation leads to a reduction in investment, and even underinvestment, in both periods if the firm faces financing constraints.

We test these theoretical predictions using data on Chinese listed companies. We find that in the pre-expropriation period, firms with less tight financing constraints overinvest more if intended tunneling is considered non-severe, but they reduce investment if tunneling is severe. In contrast with the model prediction, inefficient investment for firms with tight financing constraints remains unchanged in the pre-expropriation period. The main reason is that most Chinese listed companies are large well-performing SOEs; therefore, the financing constraints are not sufficiently tight even if some of the firms are classified as having tight financing constraints. During the expropriation and post-expropriation periods, we find that expropriation does not impact inefficient investment for firms with less tight financing constraints. For firms

with tight financing constraints, our empirical results indicate that investment is reduced in the expropriation period only if the expropriation level is not too high, but investment is reduced in the post-expropriation period, regardless of whether or not tunneling is severe. Our empirical results further imply that financing constraints become tightened, reducing investment with respect with the expected level, particularly for firms with tight financing constraints, during the time when the firm is under investigation for tunneling and in the years after the sanctions on firms are imposed and announced to the public.

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Table1. Variable definitions

Variable classification	Variable	Definition
Factors that affect the opportunity cost of tunneling	*Top*1	The proportion of total shares held by the largest shareholder in the firm.
	Q	The ratio of the market value of the firm to its replacement value.
Corporate governance factors that affect investor protection	*Sep*	The ratio of control rights to cash flow rights
	Her	The sum of squared proportions of total shares held by the 5 largest shareholders in the firm.
	Ins	The proportion of total shares held by institutional investors in the firm.
	Dep	Equals 1, if a single executive holds the CEO and Board chair titles in the firm, and 0 otherwise.
	Board	Logarithm of the number of board members in the firm.
	Indp	The proportion of outside independent directors on the board of directors.
	AC	Administrative expenses divided by prime operating revenue.
	Gshare	The proportion of total shares held by corporate executives.
Other factors that affect investor protection	*Lev*	Total liabilities divided by total assets.
	Adu	Equals 1 if the firm is audited by the Big Four accounting firms, and equals 0 otherwise.
	Ph	Equals 1 if the firm has H shares listed on the Hong Kong Stock Exchange, and equals 0 otherwise.
	Law	Equals 1 if the time of observation is after January 1, 2006, and equals 0 otherwise.
Factors that affect firm financing constraints	*Gua*	Equals 1 if the firm is a large SOE or has central SOEs as loan guarantors, and 0 otherwise.
	Sta	Equals 1 if the firm is a SOE, and equals 0 otherwise.
	Cf	Operating net cash flow divided by assets.
	Fix	Logarithm of fixed assets.
	Size	Logarithm of total assets.

This table describes the control variables in the Logit model used to estimate a firm's propensity score (PS).

Table 2. Estimation results of Regression (25)

Variable	*Q*	*Lev*	*Cash*	*Age*	*Size*	*AR*	*I*	*Constant*	R^2	*F* value	Observations
Coefficient	0.0020**	-0.0216***	0.0551***	-0.0082***	0.0048***	0.0075***	0.3660***	-0.0871***	0.2934	143.34	17338
(t-value)	(2.95)	(-8.31)	(12.69)	(-12.51)	(10.31)	(6.61)	(34.46)	(-8.69)			

This table reports the estimated coefficients in the regression model for estimating inefficient investment. *Q* is Tobin's Q for firm *i* in year *t* – 1 used to capture investment opportunities. *Lev*, *Cash*, *Age*, *Size*, *AR*, and *I* are the degree of leverage calculated as a ratio of total assets to total liabilities, the cash balance scaled by total assets, firm age defined as the logarithm of the number of years since the firm was founded, firm size measured by the logarithm of total assets, stock return, and net investment in the previous year, respectively. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Descriptive statistics of inefficient investment and variables that affect tunneling

	All firms			Firms with less tight financing constraints			Firms with tight financing constraints		
	Observations	Mean	St. Dev.	Observations	Mean	St. Dev.	Observations	Mean	St. Dev.
II	4177	-0.0011	0.0730	1148	0.0032	0.0592	2809	-0.0043	0.0786
I	4406	0.0237	0.0738	1165	0.0337	0.0691	3015	0.0174	0.0747
Q	4406	1.8075	1.6779	1165	1.5187	1.3470	3015	1.9409	1.8203
Cash	4406	0.1581	0.1288	1165	0.1526	0.1204	3015	0.1625	0.1326
AR	4362	0.2786	0.8090	1164	0.2632	0.8002	2972	0.2854	0.8155
Lev	4406	0.5579	0.3258	1165	0.5846	0.2414	3015	0.5549	0.3598
*Top*1	4406	0.3627	0.1602	1165	0.3998	0.1658	3015	0.3452	0.1559
Her	4406	0.1723	0.1293	1165	0.2022	0.1381	3015	0.1583	0.1242
Sep	4406	1.5859	1.4832	1165	1.3209	1.2937	3015	1.7013	1.4995
Ins	4406	0.2515	0.2386	1165	0.3216	0.2520	3015	0.2184	0.2240
Dep	4406	0.1528	0.3599	1165	0.1078	0.3102	3015	0.1720	0.3774
Board	4406	2.2008	0.2005	1165	2.2707	0.2192	3015	2.1717	0.1874
Indp	4406	0.3588	0.0535	1165	0.3613	0.0547	3015	0.3573	0.0526
Gshare	4406	0.0178	0.0819	1165	0.0051	0.0333	3015	0.0233	0.0957
AC	4406	0.1571	0.5505	1165	0.1191	0.5326	3015	0.1776	0.5757
Adu	4406	0.8928	0.3094	1165	0.9495	0.2190	3015	0.8629	0.3440
Ph	4406	0.0248	0.1556	1165	0.0624	0.2421	3015	0.0086	0.0922
Gua	4406	0.0396	0.1950	1165	0.1497	0.3569	3015	0.0000	0.0000
Cf	4406	0.0417	0.1264	1165	0.0475	0.1026	3015	0.0365	0.1374
Fix	4406	19.9096	1.7484	1165	20.9706	1.7715	3015	19.4287	1.5531
Size	4406	21.3460	1.3055	1165	22.3553	1.3457	3015	20.9240	1.0710

This table reports the descriptive statistics of inefficient investment and other main variables that affect tunneling for firms. *II* stands for inefficient investment in a firm. *I* is the net investment. *Q* is Tobin's Q. *Cash* is the level of cash scaled by total assets. *AR* is the stock return. *Lev* is the degree of leverage calculated as a ratio of total assets to total liabilities. *Top*1 is the proportion of total shares held by the largest shareholder in the firm. *Her* is the sum of squared proportions of total shares held by the 5 largest shareholders in the firm. *Sep* is the ratio of control rights to cash flow rights. *Ins* is the proportion of total shares held by institutional investors in the firm. *Dep* equals 1, if a single executive holds the CEO and board chair titles in the firm, and 0 otherwise. *Board* is the logarithm of the number of board members in the firm. *Indp* is the proportion of outside independent directors on the board of directors (BOD). *Gshare* is the proportion of total shares held by corporate executives. *AC* is administrative expenses divided by prime operating revenues. *Adu* equals 1 if the firm is audited by the Big Four accounting firms, and 0 otherwise. *Ph* equals 1 if the firm has H shares listed on the Hong Kong Stock Exchange, and 0 otherwise. *Gua* equals 1 if the firm is a large SOE or has central SOEs as loan guarantors, and 0 otherwise. *Cf* is operating net cash flow divided by assets. *Fix* is the logarithm of the firm's fixed assets. *Size* is the logarithm of total assets of the firm.

Table 4. Descriptive statistics of inefficient investment for firms in different periods

Panel A: Average inefficient investment for treated firms					
	Full sample	Pre-expropriation period	Expropriation year	Post-expropriation period	After sanctions on firms are imposed
II	-0.0087	0.0119	-0.0155	-0.0405	-0.0463
	(0.0891)	(0.0828)	(0.0535)	(0.1511)	(0.1458)
Observations	1934	163	570	375	419
Panel B: Inefficient investment for control firms					
II	0.0055	0.0034	0.0067	0.0185	0.0103
	(0.0545)	(0.0534)	(0.0512)	(0.0566)	(0.0536)
Observations	2243	169	575	385	441

This table reports the descriptive statistics of inefficient investment in the pre-expropriation, expropriation, and post-expropriation periods for treated firms and control firms, as well as after administrative sanctions on firms for tunneling are imposed. Standard deviations are in parentheses. *II* stands for inefficient investment.

Table 5. Regression results for the Logit model

Model 1				Model 2			
Variable	Coefficient	Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
II	-1.108	*Gshare×Law*	10.98*	*II*	-0.754	*Gshare×Law*	174.4
	(-1.23)		(1.75)		(-1.15)		(0.86)
L_II	-	*AC*	0.557**	*L_II*	0.173	*AC*	0.639**
	-		(2.06)		(0.20)		-2.25
Top1	-1.544	AC^2	-0.110**	*Top1*	-1.347	AC^2	-0.115**
	(-1.29)		(-2.42)		(-1.03)		(-2.45)
Q	-0.109**	*Lev*	2.382***	*Q*	-0.0914*	*Lev*	1.806***
	(-2.17)		(5.08)		(-1.78)		(3.61)
Sep	0.0063	Lev^2	-1.341***	*Sep*	-0.0143	Lev^2	-1.081***
	(0.22)		(-5.53)		(-0.42)		(-4.36)
Her	-0.662	*Adu*	-1.146***	*Her*	-0.96	*Adu*	-1.280***
	(-0.42)		(-7.28)		(-0.54)		(-7.61)
Her×Law	3.307***	*Ph*	-0.890*	*Her×Law*	3.089***	*Ph*	-1.009*
	(3.76)		(-1.83)		(2.94)		(-1.85)
Ins	-0.904	*Law*	-3.536**	*Ins*	-2.358**	*Law*	-2.97
	(-1.55)		(-2.22)		(-2.57)		(-1.62)
Ins×Law	0.191	*Gua*	0.263	*Ins×Law*	1.631*	*Gua*	0.248
	(0.29)		(1.04)		(1.68)		(0.93)
Dep	-0.262	*Sta*	-0.0291	*Dep*	-0.200	*Sta*	0.025
	(-1.04)		(-0.25)		(-0.65)		(0.19)
Dep×Law	0.831***	*Cf*	-1.145**	*Dep×Law*	0.748**	*Cf*	-0.949*
	(2.83)		(-2.31)		(2.17)		(-1.79)
Board	-0.625	*Fix*	0.0782	*Board*	-0.313	*Fix*	0.0628
	(-1.44)		(1.37)		(-0.59)		(1.01)
Board×Law	0.481	*Size*	-0.362***	*Board×Law*	-0.0508	*Size*	-0.281***
	(0.87)		(-4.17)		(-0.08)		(-3.02)
Indp	-3.610**	*C*	8.201***	*Indp*	-5.299**	*C*	7.102***
	(-2.15)		(4.59)		(-2.30)		(3.46)
Indp×Law	2.592	*INDUSTRY*	YES	*Indp×Law*	3.649	*INDUSTRY*	YES
	(1.23)				(1.37)		
Gshare	-10.26	*YEAR*	YES	*Gshare*	-173.3	*YEAR*	YES
	(-1.64)				(-0.86)		
Observations	4147			Observations	3662		

This table presents the estimated coefficients in the augmented Logit model. *II* represents inefficient investment, and *L_II* is one-year lagged inefficient investment. *Top*1 is the proportion of total shares held by the largest shareholder in a firm. *Q* is the ratio of the market value of the firm to its replacement value. *Sep* is the ratio of control rights to cash flow rights. *Her* is the sum of squared proportions of total shares held by the 5 largest shareholders in the firm. *Ins* is the proportion of total shares held by institutional investors in the firm. *Dep* equals 1, if a single executive hold the CEO and board chair titles in the firm, and 0 otherwise. *Board* is the logarithm of the number of board members in the firm. *Indp* is the proportion of outside independent directors on the board of directors. *Gshare* is the proportion of total shares held by corporate executives. *AC* is administrative expenses divided by prime operating revenues. *Lev* is the total liabilities divided by total assets. *Adu* equals 1 if the firm is audited by the Big Four accounting firms, and 0 otherwise. *Law* equals 1 if the time of observations is after January 1, 2006, and 0 otherwise. *Gua* equals 1 if the firm is a large SOE or has central SOEs as loan guarantors,, and 0 otherwise. *Ph* equals 1 if the firm has H shares listed on the Hong Kong Stock Exchange, and 0 otherwise. *Sta* equals 1 if the firm is a SOE, and 0 otherwise. *Cf* is operating net cash flow divided by assets. *Fix* is the logarithm of fixed assets. *Size* is the logarithm of total assets. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the industry and time effects, respectively. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Inefficient investment and expropriation

Variables	Panel A: Estimation results of Equation (28)			Panel B: Estimation results of Equation (29)		
	All firms	Firms with less tight financing constraints	Firms with tight financing constraints	All firms	Firms with less tight financing constraints	Firms with tight financing constraints
Nbe×*x*	0.0220**	0.0895***	0.0052	0.0231**	0.0897***	0.0083
	(2.21)	(4.55)	(0.55)	(2.34)	(4.55)	(0.90)
Sbe×*x*	-0.0163	-0.0381**	0.0136	-0.0145	-0.0317**	0.0151
	(-1.33)	(-2.43)	(0.79)	(-1.16)	(-1.99)	(0.86)
Nmid×*x*	-0.0300***	-0.0115	-0.0352***	-0.0303***	-0.0110	-0.0348***
	(-4.99)	(-0.91)	(-4.74)	(-5.09)	(-0.89)	(-4.78)
Smid×*x*	-0.0163	-0.0008	-0.0197	-0.0155	0.0010	-0.0184
	(-1.39)	(-0.04)	(-1.43)	(-1.32)	(0.05)	(-1.36)
Naf×*x*	-0.0412***	-0.0081	-0.0560***	-0.0423***	-0.0110	-0.0563***
	(-5.89)	(-0.53)	(-6.60)	(-6.15)	(-0.72)	(-6.62)
Saf×*x*	-0.0944***	-0.0064	-0.1200***	-0.0929***	-0.0034	-0.117***
	(-5.19)	(-0.24)	(-5.57)	(-5.09)	(-0.12)	(-5.39)
AII_t	-	-	-	1.0110***	0.6220**	1.2030***
	-	-	-	(3.68)	(2.02)	(2.83)
INDUSTRY	NO	NO	NO	YES	YES	YES
YEAR	NO	NO	NO	YES	YES	YES
C	0.0038***	-0.0019	0.0046***	0.0038	-0.0113	0.0030
	(3.47)	(-0.79)	(3.32)	(1.09)	(-1.50)	(0.82)
Observations	4177	1148	2809	4177	1148	2809
R^2	0.0530	0.0910	0.0760	0.0620	0.1090	0.0860

This table presents results of the difference-in-difference regressions for firms with different financing constraints. The dependent variable is inefficient investment estimated from Equation (25). The independent variables are 1) *Nbe*, a dummy variable equal to 1 if the observation is in the first year before a non-severe tunneling activity, and 0 otherwise; 2) *Sbe*, a dummy variable equal to 1 if the time is in the first year before a severe tunneling activity, and 0 otherwise; 3) *Nmid*, a dummy variable equal to 1 if the time is in the year of a non-severe tunneling activity, and 0 otherwise; 4) *Smid*, a dummy variable equal to 1 if the time is in the year of a severe tunneling activity, and 0 otherwise; 5) *Naf*, a dummy variable equal to 1 if the time is in the first year or second year after a non-severe tunneling activity, and 0 otherwise; 6) *Saf*, a dummy variable equal to 1 if the time is in the first year or second year after a severe tunneling activity, and 0 otherwise. *x* is a dummy variable taking the value 1 if firm *i* is in the treatment group and 0 if the firm is in the control group. $AII_{i,t}$ represents the average inefficient investment for firm *i*'s industry in year *t*. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the industry and time effects, respectively. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 7. Overinvestment/underinvestment and expropriation

	Panel A: Estimation results of Equation (28)						Panel B: Estimation results of Equation (29)					
	Overinvestment			Underinvestment			Overinvestment			Underinvestment		
	All firms	Firms with less tight financing constraints	Firms with tight financing constraints	All firms	Firms with less tight financing constraints	Firms with tight financing constraints	All firms	Firms with less tight financing constraints	Firms with tight financing constraints	All firms	Firms with less tight financing constraints	Firms with tight financing constraints
Nbe×*x*	0.0374***	0.0871***	0.0125	-0.0043	0.0377**	-0.0066	0.0371***	0.0759***	0.0125	-0.0010	0.0373**	-0.0019
	(2.90)	(4.74)	(0.95)	(-0.46)	(2.56)	(-0.83)	(2.95)	(4.22)	(0.98)	(-0.11)	(2.60)	(-0.24)
Sbe×*x*	-0.0231	0.0038	-0.0297	0.0124	-0.0552***	0.0489*	-0.0196	0.0226	-0.0271	0.0156	-0.0507**	0.0500*
	(-1.52)	(0.26)	(-1.18)	(0.65)	(-2.88)	(1.87)	(-1.30)	(1.18)	(-1.13)	(0.79)	(-2.50)	(1.82)
Nmid×*x*	-0.0143*	-0.0145	-0.0086	-0.0105	0.0195*	-0.0233***	-0.0152*	-0.0191	-0.0094	-0.0087	0.0202	-0.0209***
	(-1.75)	(-0.77)	(-0.81)	(-1.62)	(1.83)	(-3.02)	(-1.91)	(-1.02)	(-0.92)	(-1.31)	(1.58)	(-2.61)
Smid×*x*	-0.0199**	-0.0293*	-0.0211*	0.0218	-0.0098	0.0218	-0.0209**	-0.0243	-0.0233**	0.0228	-0.0156	0.0244
	(-2.09)	(-1.68)	(-1.91)	(1.56)	(-0.89)	(1.35)	(-2.19)	(-1.26)	(-2.04)	(1.64)	(-1.32)	(1.52)
Naf×*x*	-0.0331***	-0.0218	-0.0404***	-0.0235***	0.0094	-0.0390***	-0.0349***	-0.0227	-0.0417***	-0.0241***	0.0078	-0.0377***
	(-4.31)	(-1.19)	(-4.31)	(-3.82)	(0.95)	(-6.03)	(-4.60)	(-1.35)	(-4.52)	(-4.07)	(0.82)	(-5.59)
Saf×*x*	-0.0489***	-0.0082	-0.0703***	-0.0670***	-0.0190	-0.0825***	-0.0477***	-0.0121	-0.0705***	-0.0648***	-0.0245*	-0.0781***
	(-4.67)	(-0.61)	(-4.78)	(-3.04)	(-1.53)	(-3.16)	(-4.68)	(-0.68)	(-4.92)	(-2.95)	(-1.88)	(-3.02)
AII_t	-	-	-	-	-	-	0.3210	0.743*	0.2890	1.032**	0.1620	1.173**
	-	-	-	-	-	-	(1.64)	(1.70)	(1.10)	(2.23)	(0.52)	(2.03)
INDUSTRY	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
YEAR	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES
C	0.0454***	0.0440***	0.0438***	-0.0309***	-0.0326***	-0.0295***	0.0522***	0.0512***	0.0468***	-0.0405***	-0.0511***	-0.0343***
	(32.52)	(15.82)	(26.33)	(-27.49)	(-21.35)	(-18.36)	(12.94)	(5.72)	(10.90)	(-10.04)	(-7.31)	(-6.71)
Observations	1781	496	1165	2396	652	1644	1781	496	1165	2396	652	1644
R^2	0.0560	0.1310	0.0680	0.0500	0.0450	0.0740	0.0700	0.1880	0.0790	0.0640	0.1180	0.0850

This table presents results of the difference-in-difference regressions for firms with different financing constraints. The dependent variable is overinvestment or underinvestment estimated from Equation (25). The independent variables are 1) *Nbe*, a dummy variable equal to 1 if the observation is in the first year before a non-severe tunneling activity, and 0 otherwise; 2) *Sbe*, a dummy variable equal to 1 if the time is in the first year before a severe tunneling activity, and 0 otherwise; 3) *Nmid*, a dummy variable equal to 1 if the time is in the year of a non-severe tunneling activity, and 0 otherwise; 4) *Smid*, a dummy variable equal to 1 if the time is in the year of a severe tunneling activity, and 0 otherwise; 5) *Naf*, a dummy variable equal to 1 if the time is in the first year or second year after a non-severe tunneling activity, and 0 otherwise; 6) *Saf*, a dummy variable equal to 1 if the time is in the first year or second year after a severe tunneling activity, and 0 otherwise. *x* is a dummy variable taking the value 1 if firm *i* is in the treatment group and 0 if the firm is in the control group. $AII_{i,t}$ represents the average inefficient investment for firm *i*'s industry in year *t*. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the time and industry effects, respectively. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 8. Estimation results for Equation (30)

Variables	Panel A: Results based on inefficient investment			Panel B: Results based on overinvestment or underinvestment					
	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	Overinvestment			Underinvestment		
				Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints
Nbe×*x*	0.0215**	0.0889***	0.0069	0.0359***	0.0752***	0.0117	-0.0020	0.0384***	-0.0031
	(2.19)	(4.51)	(0.75)	(2.84)	(4.12)	(0.91)	(-0.21)	(2.70)	(-0.38)
Sbe×*x*	-0.0214*	-0.0338**	0.0073	-0.0224	0.0241	-0.0297	0.0108	-0.0482**	0.0458*
	(-1.82)	(-2.02)	(0.44)	(-1.43)	(1.23)	(-1.21)	(0.57)	(-2.37)	(1.72)
Nmid×*x*	-0.0293***	-0.0064	-0.0340***	-0.0144*	-0.0176	-0.0086	-0.0083	0.0202*	-0.0215**
	(-4.69)	(-0.47)	(-4.47)	(-1.82)	(-0.91)	(-0.84)	(-1.17)	(1.73)	(-2.51)
Smid×*x*	-0.0128	0.0055	-0.0151	-0.0193**	-0.0091	-0.0233**	0.0254*	-0.0190	0.0277
	(-1.05)	(0.25)	(-1.09)	(-2.01)	(-0.45)	(-2.05)	(1.74)	(-1.53)	(1.57)
Naf×*x*	-0.0331***	0.0046	-0.0483***	-0.0262***	-0.0144	-0.0331***	-0.0192**	0.0078	-0.0354***
	(-3.68)	(0.22)	(-4.45)	(-3.20)	(-0.55)	(-3.23)	(-2.18)	(0.66)	(-3.66)
Saf×*x*	-0.0706***	0.0097	-0.0889***	-0.0353***	0.0194	-0.0613***	-0.0474***	-0.0329***	-0.0539**
	(-4.38)	(0.29)	(-4.72)	(-3.46)	(0.54)	(-4.46)	(-2.61)	(-2.78)	(-2.56)
Npun×*x*	-0.0182**	-0.0262*	-0.0164*	-0.0173***	-0.0134	-0.0171**	-0.0100	0.0004	-0.0060
	(-2.33)	(-1.76)	(-1.89)	(-2.60)	(-0.55)	(-2.32)	(-1.31)	(0.05)	(-0.72)
Spun×*x*	-0.0496***	-0.0299	-0.0605***	-0.0296***	-0.0770**	-0.0224**	-0.0384**	0.0214	-0.0515***
	(-3.68)	(-1.23)	(-3.79)	(-3.04)	(-2.13)	(-2.07)	(-2.37)	(1.46)	(-2.60)
AII_t	1.044***	0.653**	1.253***	0.355*	0.777*	0.3260	1.055**	0.1270	1.225**
	(3.84)	(2.14)	(2.95)	(1.83)	(1.76)	(1.23)	(2.31)	(0.40)	(2.11)
INDUSTRY	YES	YES	YES	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES	YES	YES	YES
C	0.0037	-0.0115	0.0034	0.0520***	0.0512***	0.0466***	-0.0404***	-0.0508***	-0.0336***
	(1.08)	(-1.50)	(0.93)	(12.79)	(5.66)	(10.76)	(-10.10)	(-7.37)	(-6.68)
Observations	4177	1148	2809	1781	496	1165	2396	652	1644
R^2	0.0700	0.1150	0.0960	0.0770	0.2040	0.0840	0.0690	0.1230	0.0910

This table presents the estimation results for Equation (30) with control variables for firms with different financing constraints. The dependent variable is inefficient investment (overinvestment or underinvestment) estimated from Equation (25). The independent variables are 1) *Nbe*, a dummy variable equal to 1 if the observation is in the first year before a non-severe tunneling activity, and 0 otherwise; 2) *Sbe*, a dummy variable equal to 1 if the time is in the first year before a severe tunneling activity, and 0 otherwise; 3) *Nmid*, a dummy variable equal to 1 if the time is in the year of a non-severe tunneling activity, and 0 otherwise; 4) *Smid*, a dummy variable equal to 1 if the time is in the year of a severe tunneling activity, and 0 otherwise; 5) *Naf*, a dummy variable equal to 1 if the time is in the first year or second year after a non-severe tunneling activity, and 0 otherwise; 6) *Saf*, a dummy variable equal to 1 if the time is in the first year or second year after a severe tunneling activity, and 0 otherwise; 7) *Npun*, a dummy variable equal to 1 if the time is the year in which or one year after the administrative sanctions on firms for a non-severe tunneling activity are imposed, and 0 otherwise; 8) *Spun*, a dummy variable equal to 1 if the time is the year in which or two years after the sanctions on firms for a severe tunneling activity are imposed, and 0 otherwise. *x* is a dummy variable taking the value 1 if firm *i* is in the treatment group and 0 if the firm is in the control group. $AII_{i,t}$ represents the average inefficient investment for firm *i*'s industry in year *t*. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the industry and time effects, respectively. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 9. Estimation results of Equation (31)

Variables	Panel A: Results based on inefficient investment			Panel B: Results based on overinvestment or underinvestment					
	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	Overinvestment			Underinvestment		
				Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints
Nbe	0.0241***	0.0886***	0.0019	0.0365***	0.0830***	0.0101	-0.0054	0.0191**	-0.0032
	(2.69)	(4.76)	(0.25)	(3.23)	(4.24)	(1.29)	(-0.51)	(2.42)	(-0.30)
Sbe	-0.0309***	-0.0171**	-0.0181*	-0.0211**	0.0046	-0.0104	-0.0173	-0.0372**	-0.0064
	(-3.42)	(-1.99)	(-1.73)	(-2.04)	(0.59)	(-0.67)	(-1.39)	(-2.50)	(-0.51)
Nmid	-0.0200***	0.0059	-0.0261***	-0.0110*	-0.0016	-0.0088	-0.0067	0.0029	-0.0123**
	(-4.35)	-0.57	(-4.99)	(-1.87)	(-0.08)	(-1.13)	(-1.31)	-0.37	(-1.98)
Smid	-0.0030	0.0159	-0.0047	-0.0108	-0.0123	-0.0168*	0.0216*	-0.0037	0.021
	(-0.22)	(0.75)	(-0.30)	(-1.25)	(-0.49)	(-1.74)	(1.65)	(-0.69)	（1.52）
Naf	-0.0165**	0.0152	-0.0247***	-0.0188***	0.0162	-0.0251***	-0.0066	-0.0023	-0.0102*
	(-2.22)	(1.01)	(-3.06)	(-3.13)	(0.90)	(-4.10)	(-1.53)	(-0.28)	(-1.79)
Saf	-0.0447***	0.0142	-0.0547***	-0.0149**	-0.0089	-0.0175**	-0.0404*	-0.0042	-0.0486**
	(-2.87)	(0.41)	(-3.19)	(-2.16)	(-0.14)	(-2.60)	(-1.78)	(-0.68)	(-2.08)
Npun	-0.0168**	-0.0268*	-0.0150**	-0.0179***	-0.0104	-0.0168***	-0.0047	0.0039	-0.0046
	(-2.60)	(-1.90)	(-2.37)	(-3.92)	(-0.51)	(-3.35)	(-0.68)	(0.91)	(-0.58)
Spun	-0.0486***	-0.0383*	-0.0576***	-0.0256***	-0.0668	-0.0215***	-0.0359***	0.0034	-0.0461***
	(-4.13)	(-1.68)	(-4.32)	(-3.62)	(-1.47)	(-3.03)	(-2.87)	(0.44)	(-3.04)
AII	1.142***	0.350	1.522***	0.0066	0.144	0.0022	1.369*	0.394	1.457*
	(2.70)	(0.96)	(2.76)	(0.03)	(0.30)	(0.01)	(1.94)	(0.93)	(1.85)
ROA	0.0319***	-0.0434	0.0335***	0.0130*	-0.0059	0.0143*	0.0477***	0.0354	0.0477***
	(4.31)	(-1.02)	(4.73)	(1.68)	(-0.35)	(1.82)	(3.26)	(1.02)	(3.22)
AC	-0.0208	-0.0171**	-0.0225	0.0042	0.0551	0.0036	-0.0455*	-0.0331***	-0.0477
	(-1.52)	(-2.42)	(-1.46)	(1.55)	(0.62)	(1.44)	(-1.68)	(-11.51)	(-1.50)
Her	-0.0543**	-0.0243	-0.0478*	-0.0039	-0.203	0.014	-0.0169	0.027	-0.0234
	(-2.28)	(-0.27)	(-1.66)	(-0.19)	(-1.46)	(0.67)	(-0.71)	(0.66)	(-0.72)
Gshare	-0.110*	-0.721**	-0.0862*	0.146**	-0.0564	0.125	-0.255**	-0.991***	-0.191
	(-1.86)	(-2.42)	(-1.79)	(2.01)	(-0.24)	(1.44)	(-2.06)	(-3.42)	(-1.60)
Sta	-0.0036	-0.0072	-0.0037	-0.0035		-0.0037	0.0103	-0.0002	0.016
	(-0.40)	(-0.39)	(-0.36)	(-0.34)		(-0.67)	(1.02)	(-0.03)	(1.43)
INDUSTRY	YES	YES	YES	YES	YES	YES	YES	YES	YES
YEAR	YES	YES	YES	YES	YES	YES	YES	YES	YES
C	0.0220**	0.0402*	0.0201*	0.0423***	0.0992***	0.0423***	-0.0262***	-0.0227*	-0.0253**
	(2.33)	(1.93)	(1.76)	(4.83)	(3.01)	(5.81)	(-2.67)	(-1.86)	(-2.17)
Observations	1768	386	1382	720	177	543	1048	209	839
R^2	0.145	0.301	0.171	0.182	0.42	0.198	0.191	0.544	0.206

This table presents results of Equation (31) for firms with different financing constraints. The dependent variable is inefficient investment (overinvestment or underinvestment) estimated from Equation (25). The dependent variable is inefficient investment calculated from Equation (25). The independent variables are 1) *Nbe*, a dummy variable equal to 1 if the observation is in the first year before a non-severe tunneling activity, and 0 otherwise; 2) *Sbe*, a dummy variable equal to 1 if the time is in the first year before a severe tunneling activity, and 0 otherwise; 3) *Nmid*, a dummy variable equal to 1 if the time is in the year of a non-severe tunneling activity, and 0 otherwise; 4) *Smid*, a dummy variable equal to 1 if the time is in the year of a severe tunneling activity, and 0 otherwise; 5) *Naf*, a dummy variable equal to 1 if the time is in the first year or second year after a non-severe tunneling activity, and 0 otherwise; 6) *Saf*, a dummy variable equal to 1 if the time is in the first year or second year after a severe tunneling activity, and 0 otherwise; 7) *Npun*, a dummy variable equal to 1 if the time is the year in which or one year after the sanctions on firms for a non-severe tunneling activity are imposed, and 0 otherwise; 8) *Spun*, a dummy variable equal to 1 if the time the year in which or one year after the sanction decision on a severe tunneling activity, and 0 otherwise. Control variables are: 1) $AII_{i,t}$, the average inefficient investment for firm *i*'s industry in year *t*; 2) *ROA*, the return on assets for the firm; 3) *AC*, administrative expenses divided by prime operating revenues; 4) *Her*, the sum of squared proportions of total shares held by the 5 largest shareholders in the firm; 5) *Gshare*, the proportion of total shares held by corporate executives. 6) *Sta*, a dummy variable equal to 1 if the firm is a SOE, and equals 0 otherwise. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the industry and time effects, respectively. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 10. Estimation results when inefficient investment is estimated using an alternative measure of investment opportunities

Variables	Panel A: Results based on inefficient investment			Panel B: Results based on overinvestment or underinvestment					
	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	(1) Overinvestment			(2) Underinvestment		
				Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints
Nbe×*x*	0.0188*	0.0816***	0.0023	0.0366***	0.0855***	0.0148	-0.0052	0.0342***	-0.0063
	(1.86)	(4.02)	(0.24)	(2.78)	(4.84)	(1.03)	(-0.53)	(2.61)	(-0.78)
Sbe×*x*	-0.0167	-0.0353**	0.0098	-0.0159	0.0172	-0.0228	0.0152	-0.0463**	0.0606*
	(-1.50)	(-2.12)	(0.62)	(-1.32)	(1.05)	(-1.28)	(0.76)	(-2.36)	(1.88)
Nmid×*x*	-0.0276***	-0.0075	-0.0327***	-0.0088	0.0058	-0.0054	-0.0069	0.0205*	-0.0194**
	(-4.44)	(-0.53)	(-4.27)	(-1.04)	(0.35)	(-0.49)	(-0.99)	(1.77)	(-2.41)
Smid×*x*	-0.0108	0.0069	-0.0128	-0.0140	-0.0033	-0.0166	0.0191	-0.0170	0.0210
	(-0.91)	(0.34)	(-0.92)	(-1.52)	(-0.19)	(-1.51)	(1.42)	(-1.39)	(1.39)
Naf×*x*	-0.0303***	0.0094	-0.0475***	-0.0209**	-0.0130	-0.0257**	-0.0178*	0.0059	-0.0359***
	(-3.29)	(0.46)	(-4.37)	(-2.38)	(-0.36)	(-2.41)	(-1.77)	(0.47)	(-3.64)
Saf×*x*	-0.0649***	0.0083	-0.0826***	-0.0357***	0.0329	-0.0594***	-0.0495***	-0.0315***	-0.0566***
	(-4.17)	-0.2600	(-4.63)	(-3.21)	-1.0000	(-4.36)	(-2.77)	(-2.89)	(-2.74)
Npun×*x*	-0.0167**	-0.0246	-0.0140	-0.0142*	-0.0071	-0.0151*	-0.0120	0.0006	-0.0062
	(-2.13)	(-1.60)	(-1.61)	(-1.97)	(-0.23)	(-1.90)	(-1.35)	(0.08)	(-0.73)
Spun×*x*	-0.0465***	-0.0270	-0.0565***	-0.0376***	-0.0846**	-0.0305**	-0.0342**	0.0356	-0.0479**
	(-3.49)	(-1.11)	(-3.55)	(-3.48)	(-2.24)	(-2.42)	(-2.22)	(1.60)	(-2.48)
C	0.0039***	-0.0016	0.0046***	0.0471***	0.0466***	0.0450***	-0.0298***	-0.0312***	-0.0285***
	(3.59)	(-0.67)	(3.46)	(32.07)	(17.26)	(26.00)	(-26.91)	(-20.05)	(-18.37)
Observations	4180	1149	2810	1730	487	1130	2374	649	1622
R^2	0.0570	0.0870	0.0810	0.0630	0.1360	0.0750	0.0530	0.0540	0.0790

This table presents results of the difference-in-difference regressions for firms with different financing constraints. The dependent variable is inefficient investment (overinvestment or underinvestment) estimated from Equation (25). The dependent variable is inefficient investment estimated from Equation (25), where the investment opportunities are measured by sales growth rate. The independent variables are 1) *Nbe*, a dummy variable equal to 1 if the observation is in the first year before a non-severe tunneling activity, and 0 otherwise; 2) *Sbe*, a dummy variable equal to 1 if the time is in the first year before a severe tunneling activity, and 0 otherwise; 3) *Nmid*, a dummy variable equal to 1 if the time is in the year of a non-severe tunneling activity, and 0 otherwise; 4) *Smid*, a dummy variable equal to 1 if the time is in the year of a severe tunneling activity, and 0 otherwise; 5) *Naf*, a dummy variable equal to 1 if the time is in the first year or second year after a non-severe tunneling activity, and 0 otherwise; 6) *Saf*, a dummy variable equal to 1 if the time is in the first year or second year after a severe tunneling activity, and 0 otherwise; 7) *Npun*, a dummy variable equal to 1 if the time is the year in which or one year after the administrative sanctions on firms for a non-severe tunneling activity are imposed and announced, and 0 otherwise; 8) *Spun*, a dummy variable equal to 1 if the time is the year in which or one year after the sanctions on firms for a severe tunneling activity are imposed, and 0 otherwise. $AII_{i,t}$ is the average inefficient investment for firm *i*'s industry in year *t*. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the industry and time effects, respectively. *x* is a dummy variable taking the value 1 if firm *i* is in the treatment group and 0 if the firm is in the control group. Coefficients on control variables are not reported. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 11. Estimation results if the tightness of firms' financing constraints is measured by firm size

Variables	Panel A: Results based on inefficient investment		Panel B: Results based on overinvestment or underinvestment			
	Firms with less tight financing constraints	Firms with tight financing constraints	Overinvestment		Underinvestment	
			Firms with less tight financing constraints	Firms with tight financing constraints	Firms with less tight financing constraints	Firms with tight financing constraints
Nbe×*x*	0.0608***	0.0154	0.0401**	-0.0053	0.0079	-0.0064
	(3.07)	(1.32)	(2.21)	(-0.57)	(1.38)	(-0.58)
Sbe×*x*	-0.0303**	-0.0175	-0.0076	0.0078	-0.0532**	0.0151
	(-1.98)	(-1.25)	(-0.41)	(0.42)	(-2.52)	(0.73)
Nmid×*x*	-0.0101	-0.0340***	0.0057	-0.0097	0.0027	-0.0190**
	(-0.85)	(-4.44)	(0.31)	(-1.38)	(0.32)	(-2.35)
Smid×*x*	-0.0100	-0.0128	0.0061	0.0242*	-0.0029	0.0216
	(-0.62)	(-0.98)	(0.35)	(1.65)	(-0.19)	(1.41)
Naf×*x*	-0.0204	-0.0371***	-0.0219	-0.0171*	-0.0168	-0.0285***
	(-1.28)	(-3.61)	(-0.91)	(-1.77)	(-1.12)	(-3.11)
Saf×*x*	-0.0498***	-0.0761***	-0.0161*	-0.0504***	-0.0270	-0.0595***
	(-2.87)	(-4.07)	(-1.82)	(-2.80)	(-1.62)	(-2.78)
Npun×*x*	-0.0068	-0.0183**	-0.0084	-0.0123	0.0173	-0.0102
	(-0.56)	(-2.07)	(-0.38)	(-1.45)	(1.61)	(-1.34)
Spun×*x*	-0.0024	-0.0551***	-0.0474***	-0.0364**	0.0114	-0.0406**
	(-0.22)	(-3.59)	(-3.42)	(-2.25)	(0.87)	(-2.23)
C	0.0034	0.0038***	0.0398***	-0.0307***	-0.0249***	-0.0321***
	(1.61)	(2.81)	(16.70)	(-27.15)	(-19.07)	(-20.62)
Observations	1000	3177	446	2396	554	1842
R^2	0.078	0.064	0.097	0.055	0.039	0.063

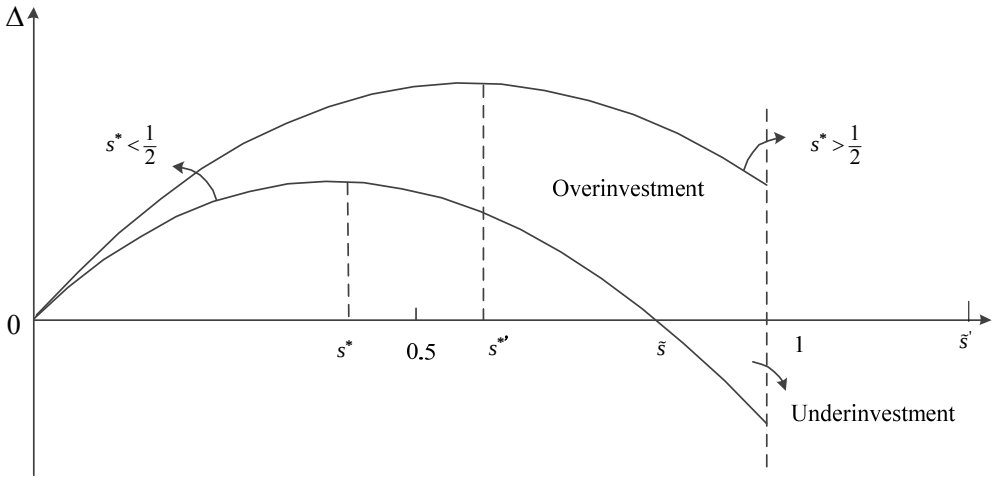
This table presents results of the difference-in-difference regressions for firms with different financing constraints. Firms are classified into two groups based only on firm size: firms with less tight financing constraints and firms with tight financing constraints. The dependent variable is inefficient investment estimated from Equation (25). The independent variables are 1) *Nbe*, a dummy variable equal to 1 if the observation is in the first year before a non-severe tunneling activity, and 0 otherwise; 2) *Sbe*, a dummy variable equal to 1 if the time is in the first year before a severe tunneling activity, and 0 otherwise; 3) *Nmid*, a dummy variable equal to 1 if the time is in the year of a non-severe tunneling activity, and 0 otherwise; 4) *Smid*, a dummy variable equal to 1 if the time is in the year of a severe tunneling activity, and 0 otherwise; 5) *Naf*, a dummy variable equal to 1 if the time is in the first year or second year after a non-severe tunneling activity, and 0 otherwise; 6) *Saf*, a dummy variable equal to 1 if the time is in the first year or second year after a severe tunneling activity, and 0 otherwise; 7) *Npun*, a dummy variable equal to 1 if the time is the year in which or one year after the administrative sanctions on firms for a non-severe tunneling activity are imposed and announced, and 0 otherwise; 8) *Spun*, a dummy variable equal to 1 if the time is the year in which or one year after the sanctions on firms for a severe tunneling activity are imposed, and 0 otherwise. $AII_{i,t}$ is the average inefficient investment for firm *i*'s industry in year *t*. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the industry and time effects, respectively. *x* is a dummy variable taking the value 1 if firm *i* is in the treatment group and 0 if the firm is in the control group. Coefficients on control variables are not reported. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Table 12. Estimation results if the treated and control firms are matched using the kernel matching method.

Variables	Panel A: Results based on inefficient investment			Panel B: Results based on overinvestment or underinvestment					
	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	Overinvestment			Underinvestment		
				Full sample	Firms with less tight financing constraints	Firms with tight financing constraints	Full sample	Firms with less tight financing constraints	Firms with tight financing constraints
Nbe×*x*	0.0203*	0.0963***	-0.0059	0.0305**	0.0689***	-0.0036	-0.0013	0.0361***	-0.0042
	(1.92)	(4.51)	(-0.55)	(2.28)	(3.15)	(-0.28)	(-0.14)	(2.96)	(-0.53)
Sbe×*x*	-0.0275**	-0.0351**	-0.0035	-0.0310*	-0.0074	-0.0365	0.0055	-0.0402**	0.0284
	(-2.34)	(-2.04)	(-0.23)	(-1.89)	(-0.71)	(-1.41)	(0.32)	(-2.01)	(1.25)
Nmid×*x*	-0.0229***	0.0017	-0.0303***	-0.0107	-0.0008	-0.0175**	-0.0108	0.0026	-0.0178**
	(-3.33)	(0.13)	(-3.36)	(-1.25)	(-0.04)	(-1.99)	(-1.45)	(0.20)	(-2.05)
Smid×*x*	-0.0066	0.0107	-0.0099	-0.0143	-0.0073	-0.0111	0.0289*	-0.0025	0.0283*
	(-0.53)	(0.51)	(-0.68)	(-1.39)	(-0.46)	(-0.93)	(1.96)	(-0.19)	(1.69)
Naf×*x*	-0.0175*	0.0168	-0.0276**	-0.0141	-0.0032	-0.0264**	-0.0162*	0.0074	-0.0287***
	(-1.86)	(0.84)	(-2.54)	(-1.46)	(-0.11)	(-2.15)	(-1.67)	(0.57)	(-2.98)
Saf×*x*	-0.0443***	0.0107	-0.0527***	-0.0256**	0.0077	-0.0316**	-0.0294**	-0.0082	-0.0368**
	(-2.75)	(0.33)	(-2.84)	(-2.34)	(0.23)	(-2.41)	(-2.01)	(-0.75)	(-2.16)
Npun×*x*	-0.0201**	-0.0254	-0.0210**	-0.0116	-0.0032	-0.0092	-0.0131	0.0014	-0.0124
	(-2.41)	(-1.53)	(-2.39)	(-1.50)	(-0.13)	(-1.01)	(-1.52)	(0.20)	(-1.43)
Spun×*x*	-0.0585***	-0.0363	-0.0706***	-0.0200**	-0.0465	-0.0213**	-0.0484***	0.0088	-0.0602***
	(-4.51)	(-1.63)	(-4.62)	(-2.44)	(-1.35)	(-2.20)	(-3.08)	(0.64)	(-3.15)
C	0.0041***	0.0004	0.00423***	0.0461***	0.0469***	0.0435***	-0.0316***	-0.0342***	-0.0302***
	(3.34)	(0.19)	(2.75)	(29.87)	(16.45)	(23.32)	(-24.90)	(-18.02)	(-18.17)
Observations	3763	1032	2731	1556	458	1098	2207	574	1633
R^2	0.061	0.102	0.081	0.068	0.155	0.065	0.056	0.086	0.079

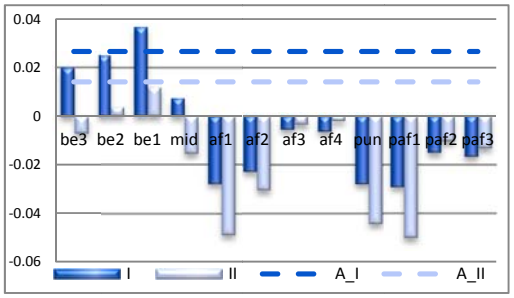
This table presents results of the difference-in-difference regressions for firms with different financing constraints. The samples in the treatment and control groups are matched using the kernel matching method. The dependent variable is inefficient investment estimated from Equation (25). The independent variables are 1) *Nbe*, a dummy variable equal to 1 if the observation is in the first year before a non-severe tunneling activity, and 0 otherwise; 2) *Sbe*, a dummy variable equal to 1 if the time is in the first year before a severe tunneling activity, and 0 otherwise; 3) *Nmid*, a dummy variable equal to 1 if the time is in the year of a non-severe tunneling activity, and 0 otherwise; 4) *Smid*, a dummy variable equal to 1 if the time is in the year of a severe tunneling activity, and 0 otherwise; 5) *Naf*, a dummy variable equal to 1 if the time is in the first year or second year after a non-severe tunneling activity, and 0 otherwise; 6) *Saf*, a dummy variable equal to 1 if the time is in the first year or second year after a severe tunneling activity, and 0 otherwise; 7) *Npun*, a dummy variable equal to 1 if the time is the year in which or one year after the administrative sanctions on firms for a non-severe tunneling activity are imposed and announced, and 0 otherwise; 8) *Spun*, a dummy variable equal to 1 if the time is the year in which or one year after the sanctions on firms for a severe tunneling activity are imposed, and 0 otherwise. $AII_{i,t}$ is the average inefficient investment for firm *i*'s industry in year *t*. *INDUSTRY* and *YEAR* are the dummy variables aiming for controlling for the industry and time effects, respectively. *x* is a dummy variable taking the value 1 if firm *i* is in the treatment group and 0 if the firm is in the control group. Coefficients on control variables are not reported. *t*-values are in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

Figure 1. Inefficient investment and expropriation fraction

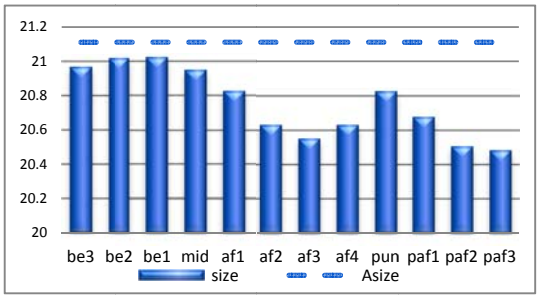


This figure plots a firm's inefficient investment as a function of the fraction of after-tax profits expropriated by its controlling shareholder. Δ represents the difference between firm actual investment and the optimal investment levels, whereas *s* stands for the expropriation fraction.

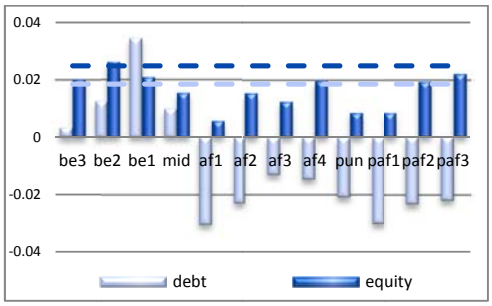
Figure 2. Firm characteristics in different periods before and after expropriation



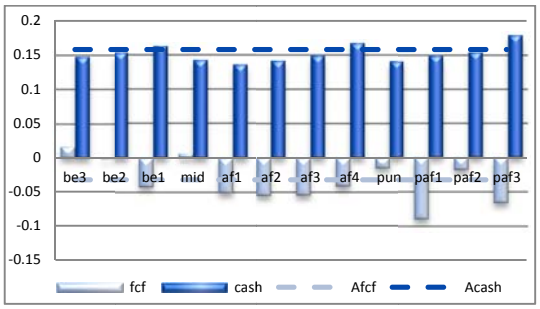
New investment and inefficient investment



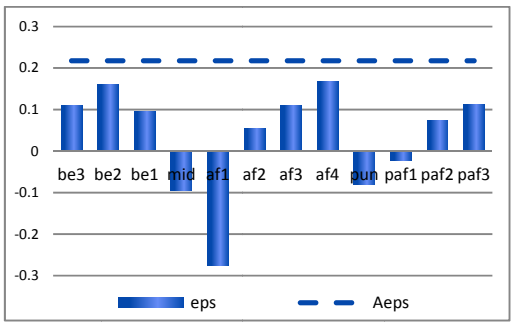
Firm size



Firm debt and equity financing



Firm free cash flow and cash balance



Earnings per share

This figure displays the average new investment (I), inefficient investment (II), logarithm of firm assets (size), debt and equity as a percentage of total assets (debt and equity), free cash flow scaled by total assets (fcf), cash balance scaled by total assets (cash), and earnings per share (eps) in various years before and after tunneling for firms with tunneling activities. A_I, A_II, Asize, AVER_debt, AVER_equity, Afcf, Acash, and Aeps represent, respectively, the average new investment, inefficient investment, firm size, debt, equity, free cash flow, cash balance, and earnings per share in the years other than the years before and after expropriation considered in the figure. be3, be2, be1, mid, af1, af2, af3, af4, pun, paf1, paf2, and paf3 represent, respectively, the third year, second year, first year before tunneling, the tunneling year, the first year, second year, third year, fourth year after tunneling, the year in which the sanctions on firms for expropriation are imposed and announced, the first year, second year, and third year after the sanctions are imposed.