Hindawi
Advances in Mathematical Physics
Volume 2022, Article ID 9431846, 12 pages
https://doi.org/10.1155/2022/9431846

Research Article

A Stochastic Approach Analysing Enterprises' Investment following Financing Reform in China

Shuxing Xiao,[1,2] Guangliang Li,[3] Weikun Zhang,[4] Mingming Zhou,[5] and Wolin Zheng[6]

[1]*School of Public Administration and Law, Hunan Agricultural University, Changsha, China*
[2]*School of Teacher Education, Shaoguan University, Shaoguan, China*
[3]*School of Economics & Management, Shanghai Ocean University, Shanghai, China*
[4]*Mangrove Institute, Lingnan Normal University, Zhanjiang, China*
[5]*School of Economics, Jiaxing University, Jiaxing, China*
[6]*School of Credit Management, Guangdong University of Finance, Guangzhou, China*

Correspondence should be addressed to Weikun Zhang; weikunz@sids.org.cn and Mingming Zhou; zhoumingming66@126.com

Received 16 May 2022; Revised 13 June 2022; Accepted 6 July 2022; Published 1 August 2022

Academic Editor: S. E. Najafi

This paper explores the change of enterprises' investment following the financing system reform through the established stochastic investment model. In this constructed model, financing property, market-oriented reform, and government intervention are regarded as a stochastic process. Furthermore, the modern China's economic situation is interpreted to analyze the enterprises' investment by government intervention plan combined with he deduced proposition from the stochastic investment model. The results provide a depth understanding for characteristics of the enterprise in China that the steady capital of state-owned enterprises' investment is higher than that of non-state-owned enterprises without government intervention before completing financing reform. Although government intervention can increase the investment level of state-owned enterprises, doing so increases the turbulence of the market economy. Additionally, the impact of government-led financing reform on enterprises' investment is asymmetrical. Promoting market-oriented, clear-cut financing reform, and reducing government-led investment plans will improve enterprises' investment efficiency and stabilize China's economic development. The present paper provides a specific future orientation of China's financing reform determining the level of enterprises' investment.

1. Introduction

China is a country with consumer power shortage, and its economic growth mainly depends on corporate investment. China can increase corporate investment through financing reform so as to get through the crisis smoothly, when the market environment is in a slump. The financing reform increased the potential output of enterprises and made economic development more resistant to economic shocks [1]. But financing reform also has some shortcomings such as placing some enterprises lacking political connection under huge financial burden due to unfair institutional contracts [2]. Yet, existing studies on enterprise investments have not identified the mechanism by which financing reform changes enterprise investment behavior.

Previous studies have shown that the financing reform by government might distort the level of enterprises' investment due to political intervention, resulting in inefficient investment [3–5]. Enterprise managers may abuse freer cash flow for overinvestment, leading to more inefficient investments [6, 7]. Other studies have shown that the financing reform was valuable in promoting efficient enterprises' investment during the financial crisis [8–11], which can better remedy market failures and compensate for inefficient market allocation [12, 13]. Financing reform can better ensure reform in enterprises' investment and economic growth faced with economic recession and external shocks,

which may result in a national fiscal deficit in the short term, but improve the output of enterprises and employment in the medium term and generate a huge fiscal surplus in the long run [14]. With the development of a market-oriented system, the rewarding priority of reform would bring the knowledge transfer spillovers [15].

This paper first attempts to build a new stochastic investment model to evaluate the consequence of the government-based financing reform. When the economic institution is relatively simple, the level can be adjusted through financing reform if something goes wrong. However, when the economic institution is more complicated, this transaction cost of correcting course is too large. In the past, many economic problems and social contradictions have been solved by massive investment expansion. If the economic growth rate declines, many contradictions and problems were revealed due to declining capital returns from enterprises' investment. The enterprise investment is related to the state administrative institution [16]. So, due to the random volatility of China's policy plan, China's financing reform defers to the Markov process containing the correction mechanism with independent increments; that is, the factor of this reform consists of the institutional constant, correction mechanism, and white noise, making deterministic quantization of financing reform difficult.

An answer to identify the enterprises' investment efficiency is relevant to the considerations for China's external capital and the government intervention-oriented plan. Based on the assumption that external capital has infinite flexibility, enterprise financing has depended to some extent on its demand for debt [17]. Unfortunately, China's capital markets, especially the stock market and bond market, were relatively unsophisticated, and bank credit has been the main source of financing for Chinese enterprises [18, 19]. If the Chinese central government intervened in enterprises' investment in response to economic depression, it would loosen the bank credit supply by implementing economic stimulus plans and release more liquidity to the market to remedy the failure of the capital market [9, 10, 11, 20]. However, Liu et al. pointed out that this policy mechanism is of great significance to the investment of state-owned enterprises, but not significant in non-state-owned enterprises' investment [21]. Despite increasing the investment in state-owned enterprises, the financing system may fail to maintain the effectiveness of these investments from state-owned ones, thus leading to overcapacity from expanding production due to government intervention. In China, there are double atrophy of output and investment in state-owned enterprises and double rise in output and investment in non-state-owned enterprises [22]

Also, the paper differentiates the state- and non-state-owned enterprises' investment function from macroenterprise investments. In China, non-state-owned enterprise is subject to unfair discrimination compared to state-owned one with which the state power has a good relationship. Although individual non-state-owned enterprises maintain a relationship with state-owned banks or governments, their ability to obtain information is less than that of state-owned enterprises; they also suffer from the discriminatory treatment of bank credit, in which banks are reluctant to lend to non-state-owned enterprises for investment [23, 24]. Even if non-state-owned enterprises is lent based on reliable business judgments [25], depending on their reputation, most of the credit goes to state-owned enterprises [21, 26]. In the case of incomplete social information, state-owned enterprises increase their level of investment, and more investments are based on private interests or the trend to crony capitalism rather than economies of scale. Wang et al. pointed out that the government may use political power to control state-owned enterprises to achieve private goals [27]. Government intervention creates market distortions under certain circumstances and leads to improper allocation of market resources [28, 29].

This paper relaxes the assumption for the certainty of the economic situation, namely, the accurate known and predicted economic status, and views the financing as a Brownian movement condition. There are inherent unobservable noneconomic fluctuations [30, 31]; that is, an economic entity cannot predict the fluctuation of economic conditions caused by disturbances in the process of economic development, and such disturbances change the information set of enterprises for future economic investment output. Truly, there are macroeconomic uncertainties in the process of financing institution reform. If the reform decision-making adjustment cost function is nonconvex, some irreversible government-led investment projects will increase the real option value of enterprise investment [32]. The uncertainty in institutional reforms, namely, the unknown and unpredicted economic consequence resulting from financing reform, can lead to an increase in the market risk premium, so that a rise in risk premiums increases corporate financing costs or difficulties and has a significant negative impact on enterprise investment [33]. In addition, the return on capital also increases with the rise in the financing cost, so the drive to perform the investment will decline, and cash holdings will tend to increase, resulting in a liquidity preference or ambiguity aversion behavior [34, 35].

This paper contributes to the growing body of literature on enterprise investment following financing reform by providing novel insights into the mechanism of enterprises' investment. The enterprises' investment effect by financing reform is reconstructed to investigate the role of government intervention through the built stochastic investment model with the consideration for the uncertainty from the economic consequence produced by institutional arrangement. Existing researches are based on the influence mechanism of financing reform and enterprise investment in developed Western capitalist countries and rarely consider the relationship between the financing reform in this particular economy and enterprise investment. The central role of China's state-owned enterprises means that its economic development is very different from western developed capitalist countries. Opportunistic behaviors such as political corruption and rent-seeking are inevitable, and distortion of market resource allocation may lead to biased corporate investment. Therefore, this paper focuses on the financing system and the random fluctuation of the reform process

and explores the relationship between the financing reform and the enterprise investment level in China.

The rest of the paper is organized as follows. The second part establishes the stochastic investment model following the financing reform; the third part solves the model and obtains the investment level of the enterprise in the steady state and the enterprise investment in the process of financing reform. The fourth part further explores changes in levels of investment in combination with China's economic development and provides a deeper deconstruction of the "structural imbalance" of the current depressed Chinese economy using propositions derived from the third part. The fifth part is the conclusion.

2. Model

2.1. The Basic Model of Enterprises' Investment. Enterprises in China, especially state-owned enterprises, have different business objectives due to the special arrangement of the property rights system, which goes beyond the maximization of profits (i.e., the sales income of enterprises minus the operating cost of raw materials) as in the West, or the maximization of outputs. It is a common practice to expand investment scale and production capacity to win political benefits because of the objectives of state-owned enterprise management (since the equilibrium prices of market commodities were unknown during China's planned economy era, the SOEs chose a quantitative index with the maximizations of their output instead of a market profit or income. Furthermore, SOE managers with correlated administrative levels at the company level sought a strong incentive to maximize productions due to the returns on companies' control property rights. For the SOE, expanding the investment scale is the common method winning the political asset (Li, 2006)). Considering that state-owned enterprises with output maximization as their quantitative objective have the dual objective of profits and production, the profit function of state-owned enterprises expressed as an instantaneous profit function is $pf(K,L) - C(K,L,I)$, where $f(\cdot)$ and $C(\cdot)$ represent production function and cost function, with p, K, L, and I representing relative prices, capital, labor, and investment related to product production. $(\theta - 1)pf(K,L)$ represents the production objective of enterprises. $\theta \geq 1$ measures the impact of property rights on firms' operations. When $\theta = 1$, property rights reform is completed. The bigger θ is, the lower the marketization from property rights reform. The actual financing cost can be characterized by the relative price of finished goods to capital goods implicit in China. We modeled χ ($\chi \geq 1$) as the commercialization of banks. When $\chi = 1$, the commercialization of banks is complete, and soft constraints are gone. The bigger the χ, the lower the commercialization of banks and the stronger the impact of soft constraints.

Of course, every aspect of economic life in China, especially dependence on government's top-down planning, involves government intervention. The government in China, according to its judgment of the economic situation, exercises its management power over state-owned enterprises and intervenes in their operation at its discretion either through administration or direction. State-owned enterprises in China are at present still subordinate to the administrative management of SASAC (State-owned Assets Supervision and Administration Commission), so the intervention of government administrative power will inevitably affect the operation of enterprises. If the government wishes to pursue rapid national economic development and requires the cooperation of state-owned enterprises, state-owned enterprises need to accomplish certain quantitative tasks, although doing so may violate the interests of state-owned enterprises. λ ($\lambda > 0$) is used for the measurement of government intervention. If $\lambda > 1$, the government hopes to expand its capacity; otherwise, the government imposes limitations over the operation of enterprises. Therefore, we have the following decision objective:

$$\lambda\chi\theta pf(K,L) - C(K,L,I), \quad \lambda > 0, \chi \geq 1, \theta \geq 1. \tag{1}$$

The difference in state- and non-state-owned enterprises is their business objectives and financing costs, so the specific modeling must be carried out in different areas for state- and non-state-owned enterprises. If two types of enterprises are assumed to have the same production technology, the investment behavior of non-state-owned enterprises could be regarded as a special case of the state-owned enterprise model; for instance, $\lambda = \chi = \theta \equiv 1$. Because non-state-owned enterprises are not administratively regulated by the Chinese government, which holds surplus control over many banks, they without the benefits of low-interest bank credit have only one profit goal to make market profits rather than political profits. Therefore, we discuss non-state-owned enterprises as a special case of state-owned enterprises, when $\lambda = \chi = \theta \equiv 1$.

2.2. The Stochastic Process Setting. A continuous time uncertain investment model is usually characterized by a random process. This paper divides the randomness into two parts: the stochastic process setting and its correlation.

It is necessary to analyze the characteristics of China's economic transformation, among which gradual reform is China's overall reform idea, including reform of the property rights system and the commercialization of banks. The miracle of China in the past 40 years of reform and opening-up demonstrates that the most worthwhile reform approach is at exploring methods guided by asymptotic market-oriented reform through government intervention. China's reform process, in fact, includes random disturbances called stochastic deviations. The benchmark, under the condition of complete marketization with the relative price of finished goods to capital goods, property rights reform, and bank commercialization reform through government intervention, is analyzed in accordance with the following geometric Brownian motion equations.

$$dp_t = \mu_p p_t dt + \sigma_p p_t dz_p, \tag{2}$$

$$d\theta_t = \mu_\theta \theta_t dt + \sigma_\theta \theta_t dz_\theta, \tag{3}$$

$$d\chi_t = \mu_\chi \chi_t dt + \sigma_\chi \chi_t dz_\chi, \tag{4}$$

$$d\lambda_t = \mu_\lambda \lambda_t dt + \sigma_\lambda \lambda_t dz_\lambda, \tag{5}$$

where μ_p, μ_θ, μ_χ, and μ_λ and σ_p, σ_θ, σ_χ, and σ_λ are constants that represent drift rate and variance rate concerning relative price, property design, commercialization of bank reform, and government intervention. dz_p, dz_θ, dz_χ, and dz_λ are set in accordance with standard Brownian motion. It is worth noting that there may be uncertainties about labor productivity in a real-life economy, but to simplify this model, stochastic changes are reflected in the random process of relative price of finished goods to capital goods variable p. It is a kind of "real price" with labor productivity or that of "relative price" compared with cost price. If China's economic transformation still adheres to reform and opening up over the long term, μ_θ and μ_χ should be less than 0, which indicates that property rights reform for state-owned enterprises has improved in the direction of the modern enterprise system, with state-owned commercial banks more and more commercialized but less affected by institutional factors. The government has no policy rules in the early stages of reform, only depending on history in the formulation and operation of policies according the actual situation, so μ_λ can be arbitrary, positive or negative, and its sign can be heterogeneous at different times.

The profits of enterprises in Equation (1) mainly come from the following three aspects:

(1) $\theta\chi$, the institutional arrangement

(2) λ, government policy decisions based on its financial status

(3) p, pure economic factors

Parameter correlations in Equations (2)–(5) can be classified into four categories. On one hand, assuming that dz_λ, dz_χ, and dz_θ have no correlation with dz_p, if $X \in (\lambda, \chi, \theta)$, the correlation coefficient is $\rho(dz_X, dz_p) = E[(dz_X - E(dz_X))(dz_p - E(dz_p))]/(\text{var}\,(dz_X)\,\text{var}\,(dz_p))^{1/2} \equiv E(dz_X dz_p)/dt$ with $E(dz_X) = E(dz_p) \equiv 0$ and $\text{var}\,(dz_X) = \text{var}\,(dz_p) \equiv dt$ due to dz in accordance with standard Brownian motion. On another hand, given that the property rights system will affect the dual goal decision-making of state-owned enterprises, and government intervention is defined as the direct administrative meddling of the government in enterprises, there is a relationship between voluntary decision-making and administrative order with $\rho(dz_\theta, dz_\lambda) = 0$, but it is possible that state-owned enterprises remain "loyal" to the government with $\rho(dz_\theta, dz_\lambda) > 0$, and we do not set $\rho(dz_\theta, dz_\lambda) > 0$ to avoid reinforcing the latter conclusion. There are still some positive correlations between λ and χ due to government management between state-owned enterprises and state-owned banks. If the outcome of the government's discretion is to stimulate investment and the economy, it would require the cooperation of state-owned enterprises and state-owned banks. When state-owned enterprises hope to stabilize product returns with the increase of λ, the state-owned banks will provide more credit under government pressure and also will be motivated to ease credit for state-owned enterprises with the increase of χ, so $\rho(dz_\lambda, dz_\chi) > 0$. The current state of the Chinese economy in the Sino-US trade war proves that the central bank has lowered its benchmark to implement a looser monetary policy, with the main credit flowing to state-owned enterprises.

(1) θ depends on the arrangement of the property rights of state-owned enterprises and the behavior characteristics of state-owned enterprises themselves

(2) χ depends on the mechanism of "rotten meat in the pot" and state-owned banks themselves

So, $\rho(dz_\chi, dz_\theta) = 0$.

In general, relaxing this assumption does not affect the conclusion of mathematical derivation in this paper, and we can conclude the following:

$$\rho_{\chi,p} = \rho_{\theta,p} = \rho_{\lambda,p} = \rho_{\theta,\lambda} = \rho_{\theta,\chi} \equiv 0\, \rho_{\lambda,\chi} > 0, \text{ where } \rho_{X,Y} = \frac{E(dz_X, dz_Y)}{dt}. \tag{6}$$

3. Model Solution and Related Propositional Deduction

3.1. Model Solution. Consider a representative state-owned enterprise whose production function is Cob-Douglas, $F_s L_s^a K_s^{1-a}$, while the cost of investment is $C(I) = \gamma I^\beta$ and $\beta > 1$ with no correlation between investment cost and investment stock, $C_K{}' = 0$. Following Equations (1)–(6), let $F \equiv \lambda\theta\chi p$. Given state variable K_t (capital stock) and F_t (including current institutional arrangement $\theta_t\chi_t$, government intervention λ_t, and pure economic factor p_t), state-owned enterprises make investment decisions to maximize the expected discounted present value $V(\cdot)$ of the income stream or investment under their dual objectives. Therefore, the maximum value function in the case of uncertainty is

$$V(K_t, F_t) = \max_{I_s, L_s} E_t \int_t^{+\infty} e^{-r(s-t)} \left[F_s L_s^a K_s^{1-a} - wL_s - \gamma I_s^\beta \right] ds, \tag{7}$$

$$\text{s.t.} dK_t = (I - \delta K_t)dt, \tag{8}$$

where w is wages and r is interest rate. δ is capital discount rate, and E_t is the expectation operator of this value function. The stochastic Bellman equation for this optimization problem is

$$rV(K_t, F_t)dt = \max_{I_t, L_t} \left[F_t L_t^a K_t^{1-a} - wL_t - \gamma I_t^\beta \right] dt + E_t(dV). \tag{9}$$

Using Ito's Lemma, we obtain

$$dV = V_K dK + V_F dF + \left(\frac{1}{2}\right) V_{KK}(dK)^2 + \left(\frac{1}{2}\right) V_{FF}(dF)^2 + V_{FK}(dF)(dK). \tag{10}$$

V_K and V and V_{KK} and V_{FF} are the first and second derivatives of subscript variables, and $V_{FK} = \partial^2 V/(\partial F \partial K)$.

Because $F \equiv \lambda\theta\chi$p, we can obtain with Ito's Lemma:

$$\begin{aligned} dF = {} & F_\lambda d\lambda + F_\theta d\theta + F_\chi d\chi + F_p dp + \left(\frac{1}{2}\right) \\ & \cdot \left[F_{\lambda\lambda}(d\lambda)^2 + F_{\theta\theta}(d\theta)^2 + F_{\chi\chi}(d\chi)^2 + F_{pp}(\mathrm{dp})^2\right] \\ & + F_{\lambda\theta}(d\lambda)(d\theta) + F_{\chi\lambda}(d\lambda)(d\chi) + F_{\lambda p}(d\lambda)(dp) \\ & + F_{\theta\chi}(d\theta)(dp) + F_{\chi P}(d\chi)(dp). \end{aligned} \tag{11}$$

$F_X = \partial F/\partial X$, with Equations (3)–(5), we obtain:

$$F_X dX = F\mu_X dt + F\sigma_X dz_X. \tag{12}$$

Because $(dt)^2 = (dt)(dz_X) \equiv 0$ and $(dz_X)^2 = dt$,

$$\begin{aligned} F_{XX}(dX)(dY) &= \frac{F}{(XY)}(\mu_X X_t dt + \sigma_X X_t dz_X) \\ &\quad \cdot (\mu_Y Y_t dt + \sigma_Y Y_t dz_Y) \\ &= F\sigma_X\sigma_Y dz_X dz_Y. \end{aligned} \tag{13}$$

With $F_{XX} = 0$, Equation (12) and equation (13) can be substituted into Equation (11), and we obtain:

$$\begin{aligned} dF = {} & F\left(\mu_\lambda + \mu_\theta + \mu_\chi + \mu_p\right) dt + F\left(\sigma_\lambda dz_\lambda + \sigma_\theta dz_\theta \right. \\ & \left. + \sigma_\chi dz_\chi + \sigma_p dz_p\right) + F\left(\sigma_\lambda\sigma_\chi dz_\lambda dz_\chi \right. \\ & \left. + \sigma_\lambda\sigma_p dz_\lambda dz_p + \sigma_\theta\sigma_\chi dz_\theta dz_\chi + \sigma_\chi\sigma_p dz_\chi dz_p\right). \end{aligned} \tag{14}$$

With $(dt)^2 = (dt)(dz_X) = 0$, $(dz_X)^2 = dt$

$$\begin{aligned} (dF)^2 &= F^2\left(\sigma_\lambda dz_\lambda + \sigma_\theta dz_\theta + \sigma_\chi dz_\chi + \sigma_p dz_p\right)^2 \\ &= F^2\left(\sigma_\lambda^2 + \sigma_\theta^2 + \sigma_\chi^2 + \sigma_p^2\right) dt + 2F\left(\sigma_\lambda\sigma_\theta dz_\lambda dz_\theta \right. \\ &\quad + \sigma_\lambda\sigma_\chi dz_\lambda dz_\chi + \sigma_\lambda\sigma_p dz_\lambda dz_p + \sigma_\chi\sigma_\theta dz_\chi dz_\theta \\ &\quad \left. + \sigma_p\sigma_\theta dz_p dz_\theta + \sigma_\chi\sigma_p dz_\chi dz_p\right). \end{aligned} \tag{15}$$

According to Equation (8), $dK = (I - \delta K)dt$, $(dK)^2 = (I - \delta K)^2(dt)^2 = 0$, and $(dK)(dF) = (I_t - \delta K_t)(dt)(dF) = 0$.

With Equation (8), Equation (14) and Equation (15) can be substituted into Equation (10), and using $E_t(dz_X) = (dt)^2 = (dt)(dz_X) = 0$, we obtain:

$$\begin{aligned} E_t(dV) = {} & \left[(I_t - \delta K_t)V_K + F\left(\mu + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)V_F \right. \\ & \left. + \left(\frac{1}{2}\right)F_t^2\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)V_{FF}\right] dt, \end{aligned} \tag{16}$$

where $\mu \equiv \mu_\lambda + \mu_\theta + \mu_\chi + \mu_p$ and $\sigma^2 \equiv \sigma_\lambda^2 + \sigma_\theta^2 + \sigma_\chi^2 + \sigma_p^2$. If Equation (16) is substituted into Equation (9), eliminating dt, we get

$$\begin{aligned} rV(K_t, F_t) = \max_{L_t, I_t}\Big\{ & \left(F_t L_t^a K_t^{1-a} - wL_t - \gamma I_t^\beta\right) \\ & + (I_t - \delta K_t)V_K + \left(\mu + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)FV_F \\ & + \left(\frac{1}{2}\right)F^2\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)V_{FF}\Big\}, \end{aligned} \tag{17}$$

where $\mu \equiv \mu_\lambda + \mu_\theta + \mu_\chi + \mu_p$ and $\sigma^2 \equiv \sigma_\lambda^2 + \sigma_\theta^2 + \sigma_\chi^2 + \sigma_p^2$.

The first-order condition for in Equation (7) is

$$\gamma\beta I^{\beta\text{-}1} = V_K. \tag{18}$$

And the first-order condition for L in Equation (7) is

$$aF_t L_t^{a-1} K_t^{1-a} = w. \tag{19}$$

So,

$$\max_{L_t}\left\{F_t L_t^a K_t^{1-a} - wL_t\right\} = hF_t^{1/(1-a)}K_t,, \tag{20}$$

where $h = (1-a)(a/w)^{a/(1-a)}$. Substituting into Equation (17) with Equation (18) and Equation (20), we obtain

$$\begin{aligned} rV(K_t, F_t) = {} & hF_t^{1/(1-a)}K_t + (\beta - 1)\gamma I_t^\beta - \delta K_t V_K \\ & + \left(\mu + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)F_t V_F \\ & + \left(\frac{1}{2}\right)F_t^2\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)V_{FF}. \end{aligned} \tag{21}$$

Let $V_K \equiv q$ represents the shadow price of capital, and we obtain the second-order partial differential equation of

$$V(K_t, F_t) = q(F)K + G(F), \tag{22}$$

where $q(F)$ and $G(F)$ is the function of F. With Equation (22) and $V_K \equiv q$ substituted into Equation (21), we obtain

$$\begin{aligned} rq(F)K_t + rG(F) = {} & hF_t^{1/(1-a)}K_t + (\beta - 1)\gamma I_t^\beta - \delta K_t q + \Big(\mu \\ & + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\Big)F(q_F(F)K + G_F(F)) + \left(\frac{1}{2}\right) \\ & \cdot \left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)(q_{FF}(F)K + G_{FF}(F)). \end{aligned} \tag{23}$$

First order of Equation (23) related to K_t:

$$rq = hF^{1/(1-a)} - \delta q + \left(\mu + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right) + Fq_F + \left(\frac{1}{2}\right)F^2\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)q_{FF}. \tag{24}$$

Equation (24) is the nonlinear second-order differential equation, called the Euler Equation, whose general solution is:

$$q(F) = BF^{1/(1-a)} + A_1F^{\eta_1} + A_2F^{\eta_2}, \tag{25}$$

where B, A_1, and A_2 are the undetermined parameters, and $\eta_1 > \eta_2$ are the two roots of $r + \delta - (\mu - \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi)\eta - (1/2)(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi)\eta(\eta - 1) = 0$. In fact, q is the shadow price of capital, and we make sure this equation does not diverge, $A_1 = A_2 = 0$

$$q(F) = BF^{1/(1-a)}. \tag{26}$$

If Equation (26) is substituted into Equation (24), we obtain:

$$B \equiv \frac{h}{r + \delta - \left(\left(\mu + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)/(1-a)\right) - \left(\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)a/2(1-a)^2\right)}. \tag{27}$$

If Equation (27) is substituted into Equation (26), we obtain:

$$qt = \frac{hF_t^{1/(1-a)}}{r + \delta - \left(\left(\mu + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)/(1-a)\right) - \left(\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)a/2(1-a)^2\right)}. \tag{28}$$

With Equation (18) and $q_t \equiv V_K$, we can obtain the optimal investment level of state-owned enterprises:

$$I_t = [q_t/\gamma\beta]^{1/(\beta-1)} = \frac{h^{1/(\beta-1)}F_t^{1/[(1-a)(\beta-1)]}}{(\gamma\beta)^{1/(\beta-1)}\left[r + \delta - \left(\mu + \rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi/(1-a)\right) - \left(\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)a/2(1-a)^2\right)\right]^{1/(\beta-1)}}. \tag{29}$$

With the differential of Equation (28) based on Ito's Lemma, we obtain:

$$\frac{dq_t}{q_t} = \frac{1}{1-a}\frac{dF_t}{F_t} + \frac{a}{2(1-a)^2}\left(\frac{dF_t}{F_t}\right)^2. \tag{30}$$

With the differential of Equation (29) based on Ito's Lemma, we obtain:

$$\frac{dI_t}{I_t} = \frac{1}{\beta-1}\frac{dq_t}{q_t} + \frac{2-\beta}{2(\beta-1)^2}\left(\frac{dq_t}{q_t}\right)^2. \tag{31}$$

With Equation (30) substituted into Equation (31), we obtain:

$$\begin{aligned}\frac{dI_t}{I_t} &= \frac{1}{\beta-1}\left(\frac{1}{1-a}\frac{dF_t}{F_t} + \frac{a}{2(1-a)^2}\left(\frac{dF_t}{F_t}\right)^2\right) + \frac{2-\beta}{2(\beta-1)^2}\left(\frac{1}{1-a}\frac{dF_t}{F_t} + \frac{a}{2(1-a)^2}\left(\frac{dF_t}{F_t}\right)^2\right)^2 \\ &= \frac{1}{\beta-1}\left(\frac{1}{1-a}\frac{dF_t}{F_t} + \frac{a}{2(1-a)^2}\left(\frac{dF_t}{F_t}\right)^2\right) + \frac{2-\beta}{2(\beta-1)^2}\left(\frac{1}{1-a}\frac{dF_t}{F_t}\right)^2.\end{aligned} \tag{32}$$

With Equation (14) and $E_t dz_X = E_t dz_p = 0$, we obtain:

$$E_t = \left(\frac{dF_t}{F_t}\right) = \left(\mu_\lambda + \mu_\theta + \mu_\chi + \mu_p\right)dt \equiv \mu dt. \tag{33}$$

With Equation (6), Equation (33), and $(dt)^2 = (dt)(dz_X) = 0$, we obtain:

$$\begin{aligned}\left(\frac{dF_t}{F_t}\right)^2 &= \left(\sigma_\lambda^2 + \sigma_\theta^2 + \sigma_\chi^2 + \sigma_p^2\right)dt + 2\sigma_\lambda\sigma_\chi\rho_{\lambda,\chi}dt \\ &\equiv \sigma^2 dt + 2\sigma_\lambda\sigma_\chi\rho_{\lambda,\chi}dt.\end{aligned} \tag{34}$$

With Equation (33) and Equation (34) substituted into Equation (32), we obtain the expected growth rate of investment in state-owned enterprises:

$$\begin{aligned}\frac{1}{dt}E\left(\frac{dI_t}{I_t}\right) = \frac{\mu}{(\beta-1)(1-a)} + \frac{a(\beta-1)+2-\beta}{2(\beta-1)^2(1-a)^2} \\ \cdot\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right),\end{aligned} \tag{35}$$

where $F_t \equiv \lambda_t\theta_t\chi_t p_t$, $\mu \equiv \mu_\lambda + \mu_\theta + \mu_\chi + \mu_p$, and $\sigma^2 \equiv \sigma_\lambda^2 + \sigma_\theta^2 + \sigma_\chi^2 + \sigma_p^2$.

The investment function of non-state-owned enterprises is only a special case of the function of state-owned enterprises when $\lambda_t = \theta_t = \chi_t \equiv 1$. The optimal investment level of non-state-owned enterprises is:

$$\widehat{I}_t = \frac{h^{1/(\beta-1)}p_t^{1/[(1-a)(\beta-1)]}}{(\gamma\beta)^{1/(\beta-1)}\left[r+\delta-\left(\mu_p/(1-a)\right)-\left(\sigma_p^2 a/2(1-a)^2\right)\right]^{1/(\beta-1)}}. \tag{36}$$

The expected growth rate of investment in non-state-owned enterprises is:

$$\frac{1}{dt}E\left(\frac{d\widehat{I}_t}{\widehat{I}_t}\right) = \frac{\mu_p}{(\beta-1)(1-a)} + \frac{a(\beta-1)+2-\beta}{2(\beta-1)(1-a)^2}\sigma_p^2. \tag{37}$$

3.2. Related Propositional Deduction

3.2.1. The Advancement of the Reform of Financing Institutions and Enterprises' Investment

Proposition 1. *Without government intervention, the steady capital of state-owned enterprises is higher than that of non-state-owned enterprises before the reform of investment institutions is completed. State-owned enterprises will always accumulate excessive capital, triggering a new round of "national advancement and civil retreat," which is not conducive to sustainable economic development.*

Proof. See Appendix A.1. □

Proposition 2. *The investment drive of state-owned enterprises can be alleviated by the reform of market-oriented financing institutions.*

Proof. See Appendix A.2. □

3.2.2. Government Intervention and Investment of Enterprises

Proposition 3. *Government intervention increases investment turbulence when it effectively regulates the investment of state-owned enterprises.*

Proof. See Appendix A.3. □

In other words, government intervention can regulate the investment level of state-owned enterprises efficiently and also increase investment turbulence, consistent with the conclusion of Gulen et al. (2016), which is not conducive to the sustainability of investment by state-owned enterprises.

Proposition 4. *The impact of government intervention behavior on enterprises' investment level is asymmetric in terms of promotion or restraint.*

Proof. See Appendix A.4. □

Given in Proposition 3, no matter whether government intervention is one-time or continuous, $dz_\lambda > 0$, $\mu_\lambda = 0$, or $dz_\lambda > 0$, $\mu_\lambda > 0$, the sustainability of state-owned enterprises' investment will increase. In addition, if the reform of financing institutions is complete, $Ed\theta_t/\theta_t = \mu_\theta = 0$, and $Ed\chi_t/\chi_t = \mu_\chi = 0$, Equation (38) can be transformed:

$$E_t g_{It} = \frac{\mu_\lambda + \mu_p}{(\beta-1)(1-a)} + \frac{[2(\beta-1)+2-\beta]\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)}{2[(\beta-1)(1-a)]^2}. \tag{38}$$

The difference in investment growth rate between state-owned enterprises and non-state-owned enterprises is (Equations (37) and (38))

$$\begin{aligned}E_t g_{It} - E_t g_{\widehat{I}_t} = \frac{\mu_\lambda + \mu_p}{(\beta-1)(1-a)} \\ + \frac{[a(\beta-1)+2-\beta]\left(\sigma_\theta^2 + \sigma_\chi^2 + \sigma_\lambda^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)}{2[(\beta-1)(1-a)]^2}.\end{aligned} \tag{39}$$

If $\beta < (2-a)/(1-a)$, the latter item in Equation (28) would be greater than 0. No matter whether $\mu_\lambda > 0$ or $\mu_\lambda = 0$, the investment growth rate of state-owned enterprises is higher than that of non-state-owned enterprises because $E_t g_{It} - E_t g_{\widehat{I}_t} > 0$. Therefore, we obtain Proposition 5.

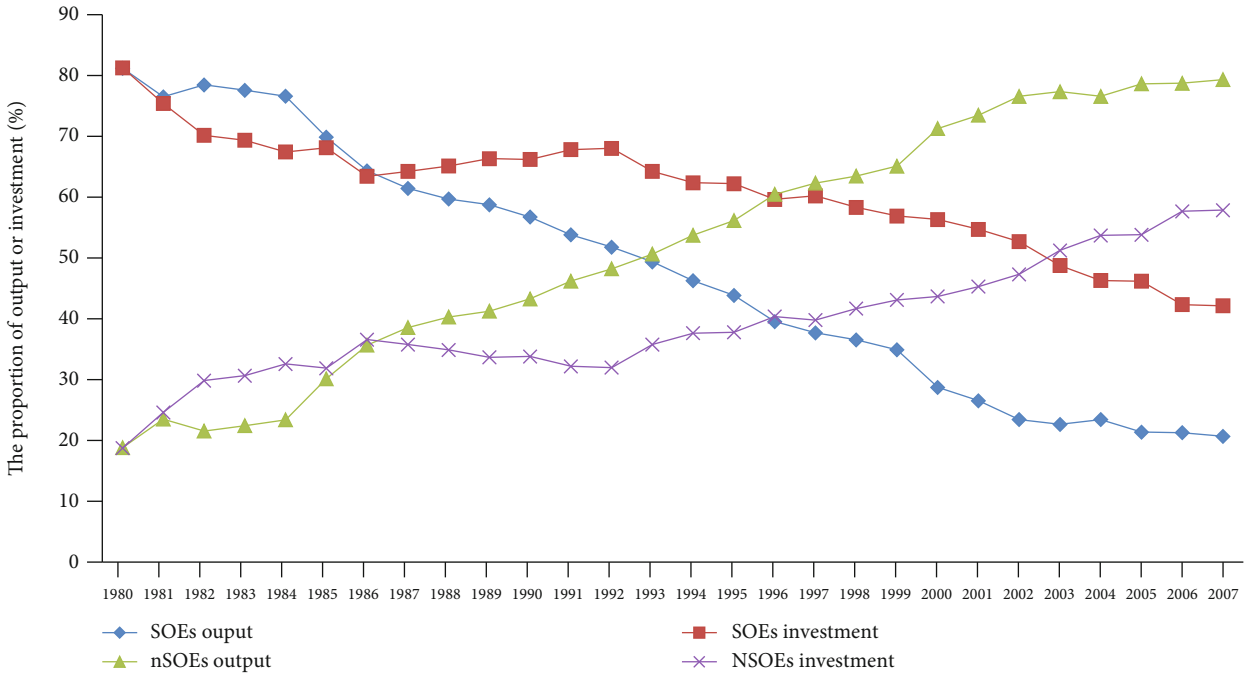

Figure 1: The proportion of output or investment of state-owned and non-state-owned enterprises. Data source: China Statistical Yearbook: 1981–2008.

Proposition 5. *If the effect of government intervention is positive, the investment drive and investment growth rate of state-owned enterprises are higher than those of non-state-owned enterprises. However, if the reform of financing institutions is stopped with* $\beta < (2-a)/(1-a)$*, the investment growth rate of state-owned enterprises is increasingly higher than that of non-state-owned enterprises.*

4. Further Discussion for China's Economic Downturn

Combined with the concrete practice of China's economic transformation and current financing institutions, the characteristic trend in enterprises' investment levels in China is analyzed in this section, with several propositions put forward based on the preceding theoretical model.

Bank loans in China are the main source of external financing for enterprises, because of the underdeveloped stock and bond market in China (Cull & Xu, 2000; Firth et al., 2008; Firth et al., 2012). State-owned enterprises accounted for 78% of new corporate loans in 2016, while non-state-owned enterprises accounted for only 17%. Deeper reform of financing institutions was implemented in the second half of 2016 by China's central government to foster a better external financing environment. However, the financing scale of non-state-owned enterprises declined from 0.86 million dollars in 2015 to 0.66 million dollars in 2017, while that of state-owned enterprises rose from 1 million dollars to 3.2 million dollars, which is a typical case of "the state advancing and the people retreating."

The emergence of a Sino-US trade war in 2018 has had a devastating impact on China's enterprises, especially for non-state-enterprise operations, due to a sharp drop in foreign demand with the decrease of μ_p. Moreover, the absolute level and growth rate of business investment will decrease, which will cause a greater economic decline such as the thunderstorm on current P2P platform in accordance with Equations (29), (35), (36), and (37). The central government in China may decide to adopt a large-scale positive economic stimulus package such as the "New 0.682 Billion Dollars Economic Stimulus Plan" announced in August 2018 to deal with the economic decline the Sino-US trade war triggered, when $dz_\lambda > 0$ and maybe $\mu_\lambda > 0$. At the same time, when local governments face a decline in their economies, they carried out 1 billion dollar leading investment plan in September 2018, and thus, dz_λ and μ_λ would be on the rise continuously. This economic stimulus package implemented in 2018, which points that state-owned enterprises and non-state-owned enterprises with politically connected and local governments must be saved, is a directional rescue compared with the plan in 2008. Revenue from local state-owned enterprises has become the main financing source of local governments since the implementation of fiscal and tax decentralization in 1994. Local governments' economic stimulus packages mainly benefit local state-owned enterprises controlled by local political power, which to a certain extent distorts resource allocation. Of course, state-owned banks also take the initiative to develop robust positive loan policies, such as the targeted cuts to required reserve ratios that release 1,081 billion dollars in credit in October 2018, when $\rho_{\lambda,\chi} > 0$ brings $dz_\chi > 0$ and $d\chi/(\chi dt)$

> 0. When the central government grants property rights to state-owned enterprises, it also gives them political advantages, scale advantages, and market advantages. State-owned bank loan credit might give first place to state-owned enterprises, especially central enterprises, due to their national political power from their soft constraints on credit, meaning that the investment level of state-owned enterprises may increase. The result may be another example of "the state advancing and the people retreating." The outcome of excessive accumulation of capital and rapid investment of state-owned enterprises would further strengthen the inefficiency of their investment, based on Propositions 1 and 5. When the government realized the problem of inefficient investment, it decided to "restructure" to maintain efficiency. The difficulty and complexity of hindering enterprises' investment and economic growth largely outweigh its positive ability, unless it again deepens the reform of financing institutions, due to the asymmetry explained by Proposition 4 and Proposition 5.

According to Proposition 5, although the past evolution of the investment system would lead to "the state retreating and the people advancing," the reverse would happen with massive government intervention, especially if the financing reform is suspended. We also contribute to the current debate on whether "the state is advancing and the people retreating" or not: the development in China is bound to be "the state retreating and the people advancing" as stated by Liu et al. (2016), in contrast to before 1978, but it is "the state advancing and the people retreating" surely in response to recent economic circumstances. Hence, the "state advancing and the people retreating" due to government intervention has a number of costs, including the low efficiency of state-owned enterprise investment and greater instability in the national economy. We thus obtain Proposition 6.

Proposition 6. *The implementation of market-oriented reform of investment institutions and the reduction of government-led economic stimulus plans will improve the efficiency of investments and reduce volatility.*

To be clear, we are not opposed to a stimulus package to deal with the recent economic decline, but we need to know its purpose. The implementation of a robust positive economic stimulus plan in regard to this depression would further aggravate the inefficiency of state-owned enterprises' investment level, as suggested by Proposition 5. Although the current administrative and investment intervention of the Chinese government may achieve good results in the short term, it could also be accompanied by huge costs, such as the low efficiency of investment, repeated construction (the supply of products or services whose quality is not as good as the existing products or services is greater than the social demand) in the long term, and nonperforming loans. The government should focus on domestic demand such as increasing household income and guiding household consumption, which may be more and more effective than the leading positive financing policy.

σ^2 and $\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi$ in Equation (29) provide the impact for uncertainty (second order) of financing reform on state-owned enterprises' investment. If uncertainty about the financing reform ($\sigma_\theta\sigma_\chi\sigma_\lambda$) increases, state-owned enterprises' investment level will increase as the denominator in Equation (29) decreases. In addition, an increase in uncertainty of reform of financial institutions will improve the expected investment growth rate of state-owned enterprises only with $\beta < (2-a)/(1-a)$. That is, if the central government in China carries out regular and normative reform of financial institutions (conforming to objective criteria defining the scope of powers and responsibilities of local government and enterprises), the variance rate (σ_θ, σ_λ, and σ_χ) in Equations (3)–(5) will drop, which means that the investment and expected growth rate of state-owned enterprises will decline. Hence, we obtain Proposition 7.

Proposition 7. *Poor financing reform may increase the investment level of state-owned enterprises, but regular and normative reforms that are fair and just can reduce economic volatility.*

Using enterprises' investment to stimulate economic growth has become our "conventional weapon" for macrocontrol. Because the financing reform involves a great deal of uncertainty, it may result in excessive investment among state-owned enterprises and thus have consequences such as waste of resources, environmental pollution, and economic overheating. When these consequences emerge, unless social planners under the financing reform (which could cause economic upheaval), it will be much more difficult to regulate the economic system, in accordance with propositions (5) and (6). Proposition 7 indicates that the evolution of systemic reform and financing reform will reduce price fluctuation and the overinvestment of state-owned enterprises, which will stabilize market supply and alleviate the "distortion" of economic structure.

5. Conclusion

The financing reform in China in connection with enterprises' investment behavior is generally advancing in the direction of marketization. The reform is gradual, in which government intervention is of a "discretionary" nature. In this paper, we establish the stochastic investment to explore the change of enterprises' (especially state-owned enterprises) investment and interpret the modern China's economy. We can transform the evolution of the financing reform and government intervention into a stochastic process and implant it into a classical enterprise investment model to construct a stochastic theory investment model to analyze the trend of enterprises' investment level in China's transition period, which suggests the following conclusions. First, the advancement of property rights and the financing reform before 2008 may have reduced state-owned enterprises' investment level and outputs in contrast with non-state-owned enterprises, to some extent bringing about "the state retreating and the people advancing." Second, if

the government does not intervene economically and the financing reform remains incomplete, the stable capital accumulation of state-owned enterprises is higher than that of nonstate enterprises. However, it could aggravate this economic instability, resulting in "the state advancing and the people retreating," though government intervention and random reform of financing institutions could increase state-owned enterprises' investment level. The promoting or restraining effect of government intervention on enterprises' investment level appears to be asymmetric. Third, the decrease of government-led investment and market-oriented or normative reform of financing institutions could improve the efficiency of enterprises' investment levels and reduce economic turmoil and promoting social welfare.

For the record, the regular and normative reform of financing institution this paper proposes is an updated version of the top-down design suggested by China's social planners in 2011. It is a pity that this design has not been carried out by China's local governments, and the policy has been implemented through mandatory monopoly plan directives such as the circuit breaker in 2016. Deepening reform of financing institutions has been mentioned in the "opinions on deepening financing reform" published by the CPC Central Committee and State Council in 2016 and in the report of the nineteenth national congress of the CPC in 2017. However, this statement only refers to a specific target, without mentioning a standard, specific implementation plan and specific institutional guarantee. "Shouting slogans" and "singing with high voices" will not develop China's economy and improve the efficiency of social investment. The market-oriented reform of financing institutions regulates the relationship between local government and enterprises, through contract law protected by legal institutions, though the antimonopoly law of 2007 and the law on unfair competition in commodities of 2018 were promulgated without exact criteria for "monopoly" and "unfair competition," and are thus unenforceable. A market-oriented reform of financing institutions needs fair, clear, and equitable rules to balance the interests of local governments and enterprises.

The article only discusses "what should be done," but the question of "how to do it" still needs more in-depth and systematic analysis. Its conclusion could help deepen the understanding of enterprises' investment behavior in response to the reform of financing institutions and current investment phenomena in China's transition period. Of course, this paper also has some shortcomings, which should be supplemented by future research. It has focused its analysis on China's state-owned enterprises and adopted a general setting for non-state-owned enterprises. Non-state-owned enterprises in China also have some irrational characteristics, which should be the focus of future research. In addition, the short-term and long-term effects of China's economic depression as a result of the Sino-US trade war have not been discussed in this paper. What intervention should the government make, such as intervening in the hiring practices or investment of enterprises, especially state-owned enterprises? This question might be the focus of our future research.

Appendix

A. Proof of Proposition

A.1. Proof of Proposition 1. When capital reaches a steady state, capital stock remains unchanged: $dK_t = (I - \delta K_t)dt \equiv 0$, $I \equiv \delta K_t$. That is to say, steady-state investment is used to offset capital discount. The value objective function of Equation (7) for state-owned enterprises with $I \equiv \delta K_t$ and Equation (18) is transformed into

$$\max_{K_s} E_t \int_t^{+\infty} \left[hF_s^{1/(1-a)} K_s - \gamma(\delta K_s)^{\beta} \right] \exp\left(-r(s-t)\right) ds. \tag{A.1}$$

The equilibrium value of this objective function of Equation (A.1) relative to K_s is

$$K_s^{st} = \left(\frac{hF_s^{1/(1-a)}}{\gamma\beta\delta^{\beta}} \right)^{1/(\beta-1)}. \tag{A.2}$$

If there is no government intervention, then $\lambda_2 \equiv 1$, and the equilibrium value of the objective function of Equation (A.1) relative to K_s is

$$K_s^{st} = \left(\frac{h(\theta_s \chi_s p_s)^{1/(1-a)}}{\gamma\beta\delta^{\beta}} \right)^{1/(\beta-1)}. \tag{A.3}$$

The stable capital for state-owned enterprises $(\theta_s \chi_s > 1)$ before the reform of financial institution is complete is higher than that of non-state-owned enterprises $(\theta_s = \chi_s \equiv 1)$. Therefore, state-owned enterprises always accumulate capital in excess.

In addition, the financing reform from mainly occurred after the worldwide financial crisis in 2008. Because SOE output is lower than nSOE output and the former's investment higher than the latter's, the former's investment efficiency (e.g., output divided by investment) is higher than the latter's, as shown in Figure 1.

A.2. Proof of Proposition 2. The reform of market-oriented financing institutions can reduce θ_t and χ_t. F_t will decrease over time due to $F_t = \lambda_t \theta_t \chi_t p_t$. The optimal investment level of state-owned enterprises in Equation (29) also decreases with time. After the reform of market-oriented financing institutions, $\mu_\theta < 0$, and $\mu_\chi < 0$, but if this reform has not been accomplished, $\mu_\theta = \mu_\chi = 0$. The denominator of the investment function in reform becomes larger with $\mu_\theta = \mu_\chi = 0$, $\mu_\theta < 0$, and $\mu_\chi < 0$ substitutes into Equation (29); that is, $I|_{\mu_\theta<0\mu_\chi<0} < I|_{\mu_\theta=\mu_\chi=0}$. Let $(1/dt)E(dI/I_t) \equiv E_t g_{It}$. Then, the reform of market-oriented institutions reduces the expected rate of enterprises with $E_t g_{It}|_{\mu_\theta<0\mu_\chi<0} < E_t g_{It}|_{\mu_\theta=\mu_\chi=0}$.

In sum, the sustainability of investment by state-owned enterprises could be reduced by the reform of market-oriented institutions through institutional design F_t, the

impact of drift rate $\mu_{\theta \text{ or } \chi}$, and the change of expected growth rate. Above all, the impact of $\mu_\theta < 0$ and $\mu_\chi < 0$ changes the expectation of institutional design F_t and that of the income discount in the enterprise objective function. Furthermore, institutional design F_t and $\mu_\theta < 0$ or $\mu_\chi < 0$ both decrease the expected growth rate of enterprises, whereas $\mu_{\theta \text{ or } \chi}$ mostly decreases the absolute level of enterprises' investment. Therefore, the reform of China's marketization is effective at present.

A.3. Proof of Proposition 3. If the government decides to get involved in expanding or reducing all-over social production capacity, μ_λ and dz_λ in Equation (5) will change. If government intervention is short-term, $dz_\lambda > 0$ and $\mu_\lambda = 0$; but if it continues for a long time, $dz_\lambda > 0$, and $\mu_\lambda > 0$.

Whatever the government intervention, it will greatly affect the investment behavior of state-owned enterprises. If the government hopes that state-owned enterprises will expand their investment level, this will affect the real investment sustainability of state-owned enterprises. As long as the government engages in intervention behavior, $dz_\lambda > 0$, $d\lambda_t/(\lambda_t dt)$ in Equation (5) will increase, because $\rho_{\lambda,\chi} > 0$, $dz_\lambda > 0$, and $d\chi_t/(\chi_t dt)$ in Equation (4) will increase. I_t in Equation (29) will increase as λ_t and χ_t increase. When $dz_\lambda > 0$, $\mu_\lambda > 0$ will make the denominator in Equation (29) decrease and increase the investment level; in addition, $E_t g_{1t}$ increases. Thus, continuous government intervention changes the absolute investment level of enterprises and their expected growth rate of investment.

A.4. Proof of Proposition 4. The effect of continuous government intervention behavior on state-owned enterprises' investment level appears to be asymmetric. We obtain this result by substituting $\mu \equiv \mu_\lambda + \mu_\theta + \mu_\chi + \mu_p$ into Equation (35):

$$E_t g_{1t} = \frac{\mu_\lambda}{(\beta-1)(1-a)} + \phi, \phi \equiv \frac{\mu_\theta + \mu_\chi + \mu_p}{(\beta-1)(1-a)} + \frac{[a(\beta-1)+2-\beta]\left(\sigma^2 + 2\rho_{\lambda,\chi}\sigma_\lambda\sigma_\chi\right)}{2[(\beta-1)(1-a)]^2}. \tag{A.4}$$

The effect μ_λ between positive change (Δ) and negative change $(-\Delta)$ has the same strength over the expected investment growth rate of state-owned enterprises unless $\phi = 0$ is different; that is, $E_t g_{It}|_{\mu_\lambda=\Delta} \neq -E_t g_{It}|_{\mu_\lambda=-\Delta}$. Of course, $\phi = 0$ is only a coincidental situation. Therefore, government intervention has an asymmetrical impact on the promotion or restraint of enterprises' investment levels.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no competing interest.

Acknowledgments

This work was supported by the Open Project of Mangrove Institute, Lingnan Normal University (grant number: PYXM03), and 2022 Annual Planning Topic, Qingyuan Philosophy and Social Sciences (grant number: QYSK2022018).

References

[1] M. Campello, R. P. Ribas, and A. Wang, "Is the stock market just a side show? Evidence from a structural reform," *NBER Working Papers*, vol. 3, no. 1-2, pp. 1–38, 2014.

[2] Q. Gou, Y. Huang, and J. Xu, "Does ownership matter in access to bank credit in China?," *European Journal of Finance*, vol. 24, no. 16, pp. 1409–1427, 2018.

[3] A. D. R. Atahau and T. Cronje, "Bank lending: the bank ownership focus in the pre- and post-global financial crisis periods," *Economic Systems*, vol. 44, no. 4, p. 100813, 2020.

[4] T. Arifin, I. Hasan, and R. Kabir, "Transactional and relational approaches to political connections and the cost of debt," *Journal of Corporate Finance*, vol. 65, p. 101768, 2020.

[5] L. A. Mariani, "Government-owned banks and development: on unintended consequences of bank privatizations," *Job Market Paper*, vol. 9, 2020.

[6] M. C. Jensen and W. H. Meckling, "Theory of the firm: managerial behavior, agency costs and ownership structure," *Corporate Governance. Gower*, vol. 4, pp. 77–132, 2019.

[7] J. Ha and M. Feng, "Tax avoidance and over-investment: the role of the information environment," *Journal of Corporate Accounting & Finance*, vol. 32, no. 1, pp. 48–77, 2021.

[8] H. Tong and S.-J. Wei, "Did unconventional interventions unfreeze the credit market?," *American Economic Journal: Macroeconomics*, vol. 12, no. 2, pp. 284–309, 2020.

[9] M. Giannetti and A. Simonov, "On the real effects of bank bailouts: micro evidence from Japan," *American Economic Journal: Macroeconomics*, vol. 5, no. 1, pp. 135–167, 2013.

[10] Y. Lin, A. Srinivasan, and T. Yamada, *The effect of government bank lending: evidence from the financial crisis in Japan*, Social Science Electronic Publishing, 2015.

[11] Y. S. Chen, Y. Chen, I. Hasan, and C. Y. Lin, "Is there a bright side to government banks? Evidence from the global financial crisis," *Journal of Financial Stability*, vol. 26, no. 8, pp. 128–143, 2016.

[12] M. Bachmann, *Market Illiquidity, Credit Freezes and Endogenous Funding Constraints*, no. 255, 2018Department of Economics Working Paper, 2018.

[13] L. Agnello, V. Castro, J. T. Jalles, and R. M. Sousa, "What determines the likelihood of structural reforms," *European Journal of Political Economy*, vol. 37, no. 10, pp. 129–145, 2015.

[14] T. Krebs and M. Scheffel, *Structural Reform in Germany*, no. 1, 2014Social Science Electronic Publishing, 2014.

[15] E. Dablanorris, G. Ho, and A. Kyobe, "Structural reforms and productivity growth in emerging market and developing economies," *IMF Working Papers*, vol. 16, no. 15, pp. 1–11, 2016.

[16] D. Castellani, E. Giaretta, and R. Staglianò, "Early-stage financing diversity and firms' export intensity: a cross-

country analysis," *Finance Research Letters*, vol. 44, no. 1, p. 102030, 2021.

[17] G. Fraser-Sampson, *The Pillars of Finance: The Misalignment of Finance Theory and Investment Practice*, Springer, 2014.

[18] H. Shen, H. Wu, W. Long, and L. Luo, "Environmental performance of firms and access to bank loans," *The International Journal of Accounting*, vol. 56, no. 2, p. 2150007, 2021.

[19] M. Firth, P. H. Malatesta, Q. Xin, and L. Xu, "Corporate investment, government control, and financing channels: evidence from China's listed companies," *Journal of Corporate Finance*, vol. 18, no. 3, pp. 433–450, 2012.

[20] H. Tong and S. J. Wei, "Did unconventional interventions unfreeze the credit market? Some international evidence," *SSRN Electronic Journal*, p. 1742014, 2011.

[21] Q. Liu, X. Pan, and G. Tian, "To what extent did the economic stimulus package influence bank lending and corporate investment decisions? Evidence from China," *Journal of Banking & Finance*, vol. 86, no. 4, pp. 177–193, 2018.

[22] Y. Zhang, M. Zhang, Y. Liu, and R. Nie, "Enterprise investment, local government intervention and coal overcapacity: the case of China," *Energy Policy*, vol. 101, no. 11, pp. 162–169, 2017.

[23] A. Popov, "Evidence on finance and economic growth," *Handbook of Finance and Development*, vol. 7, pp. 63–104, 2018.

[24] Y. Chen, M. Liu, and J. Su, "Greasing the wheels of bank lending: evidence from private firms in China," *Journal of Banking & Finance*, vol. 37, no. 7, pp. 2533–2545, 2013.

[25] N. Azevedo, M. Mateus, and Á. Pina, "Bank credit allocation and productivity: stylised facts for Portugal," *Studies in Economics and Finance*, vol. 39, no. 4, pp. 644–674, 2022.

[26] C. Wong, "The fiscal stimulus programme and public governance issues in China," *OECD Journal on Budgeting*, vol. 11, no. 3, pp. 1–22, 2011.

[27] Y. Wang, G. Luo, and Y. Guo, "Why is there overcapacity in China's PV industry in its early growth stage?," *Renewable Energy*, vol. 72, no. 7, pp. 188–194, 2014.

[28] J. Wang, Y. Dong, J. Wu, R. Mu, and H. Jiang, "Coal production forecast and low carbon policies in china," *Energy Policy*, vol. 39, no. 10, pp. 5970–5979, 2011.

[29] S. Wu, K. X. Li, W. Shi, and Z. Yang, "Influence of local government on port investment: implications of China's decentralized port governance system," *Maritime Policy & Management*, vol. 43, no. 7, pp. 777–797, 2016.

[30] N. Bloom, "Fluctuations in uncertainty," *Journal of Economic Perspectives*, vol. 28, no. 2, pp. 153–176, 2014.

[31] G. Segal, I. Shaliastovich, and A. Yaron, "Good and bad uncertainty: macroeconomic and financial market implications," *Journal of Financial Economics*, vol. 117, no. 2, pp. 369–397, 2015.

[32] B. Kelly, Ľ. Pástor, and P. Veronesi, "The price of political uncertainty: theory and evidence from the option market," *The Journal of Finance*, vol. 71, no. 5, pp. 2417–2480, 2016.

[33] S. Gilchrist, J. W. Sim, and E. Zakrajšek, "Uncertainty, financial frictions, and investment dynamics," *Finance and Economics Discussion Series*, vol. 2014, no. 69, pp. 1–58, 2014.

[34] L. Pastor and P. Veronesi, "Uncertainty about government policy and stock prices," *Journal of Finance*, vol. 67, no. 4, pp. 1219–1264, 2012.

[35] H. Kim and H. Kung, "The asset redeployability channel: how uncertainty affects corporate investment," *Review of Financial Studies*, vol. 30, no. 1, pp. 245–280, 2017.