上海交通大學

SHANGHAI JIAO TONG UNIVERSITY

# 学士学位论文

BACHELOR'S THESIS


论文题目： Asset Bubble and Political Connection

**学生姓名**: 张译元

**学生学号**: 516120910124

专　　业: 经济学（试点班）

**指**导教师: 许**志**伟

**学院(系)**: **安泰**经济与管理学院

# 上海交通大学
# 毕业设计（论文）学术诚信声明

本人郑重声明：所呈交的毕业设计（论文），是本人在导师的指导下，独立进行研究工作所取得的成果。除文中已经注明引用的内容外，本论文不包含任何其他个人或集体已经发表或撰写过的作品成果。对本文的研究做出重要贡献的个人和集体，均已在文中以明确方式标明。本人完全意识到本声明的法律结果由本人承担。

作者签名： 张译元

日期： 2020 年 6 月 24 日

# 上海交通大学
# 毕业设计（论文）版权使用授权书

本毕业设计（论文）作者同意学校保留并向国家有关部门或机构送交论文的复印件和电子版，允许论文被查阅和借阅。本人授权上海交通大学可以将本毕业设计（论文）的全部或部分内容编入有关数据库进行检索，可以采用影印、缩印或扫描等复制手段保存和汇编本毕业设计（论文）。

**保密**□，在___年解密后适用本授权书。

本论文属于

**不保密**√。

（请在以上方框内打“”）

作者签名：张译元　　指导教师签名： 

日期：2020 年 6 月 24 日　　日期：2020 年 6 月 24 日

# 资产泡沫和政治关联

## 摘要

在本文中，我先利用外生的反腐败运动和中国艺术品的独特交易数据，从实证经验上识别资产泡沫与政治联系之间的正向关系。 为了更好地理解这种关系影响经济体的机制以及定量地评估反腐败政策的对宏观经济的影响，我们构建了一个内嵌泡沫的资产市场的两部门动态一般均衡模型。 然后，我们使用我们的模型定量地研究反腐败政策的宏观经济结果。 我们发现，当腐败受到抑制时，泡沫会随着流动性溢价的减少而贬值，有形资本的价值会增加。 结果，投资和资本会在部门间重新配置。 总而言之，反腐败政策减轻了政治资本的挤出效应，减少了部分企业的低效过度投资，增加了消费，从而提高了社会福利。

关键词：资产泡沫，反腐败，宏观经济，再分配效应，政治关联

# ASSET BUBBLE AND POLITICAL CONNECTION

## ABSTRACT

In this paper, we first use exogenous anti-corruption campaigns and unique transaction data of China's artwork to identify the positive relationship between the asset bubble and political connection. To understand the empirical patterns and the transmission mechanism of connection on macroeconomy, we construct a two-sector dynamic general equilibrium model of the corrupt bubbly asset market. We then use our model to study the macroeconomic consequences of the anti-corruption policy. We find that when corruption is impeded, the bubble devalues with decreasing liquidity premium and the value of physical capital increases. As a result, the investment and capital flow from one sector to the other sector. In a sum, the anti-corruption policy alleviates the crowd effect of the political capital, decreases the inefficient overinvestment of firms, and increases the consumption, which raises the social welfare.

**Key words:** bubble, anti-corruption, macroeconomic, reallocation effect, political connection

# Contents

# 1. Introduction

China's artwork is closely linked to building the political connection. With portable size, high value, and a sense of elegance and luxury, the artwork is very proper gifts for the officials, who are artsy-fartsy and have enough energy to appreciate them. Both data and news support this point. We can find a number of scandals of investigated officials at various levels about receiving the artwork when searching "雅贿" (elegant bribery) in Google or Baidu – China's most popular search engine. Additionally, China's artwork market experienced a large fluctuation during the anticorruption period from September 2012 to September 2014. Specifically, the prices of paintings and ceramic artwork drop sharply after anti-corruption campaigns (see figure 1, the gray areas indicate four post-anti-corruption policies periods). These facts contribute to a claim that bubbles exist in the market of bribery goods.

What causes this kind of bubble? What role do bubbles play in resource allocation and the whole economy? How the bubbles can help us make sense of the implications of the anti-corruption policy? To address these questions, we construct a dynamic general equilibrium model with endogenously emerging as rational bubbles in an infinite-horizon production economy with incomplete markets.

We first test the relationship between bubbles and corruption empirically using exogenous anticorruption campaigns launched by president Xi Jinping. The empirical outcome suggests a positive relationship between the bubble and the corruption after considering factors that determine the fundamental value. Furthermore, the more popular the assets are for bribery, the larger percentage their prices decrease to after anti-corruption campaigns.

To understand the empirical patterns, we construct a two-sector dynamic general equilibrium model of the corrupt bubbly asset market. We then use our model to study the macroeconomic consequences of the anti-corruption policy. We aim to explain the reason why bubble forms and the transmission mechanism of the anti-corruption policy. In our model, final goods are produced by firms in two sectors: one sector with easy access to the political connection (PC) and the other with no political connection (NPC).

In each sector, heterogeneous firms face idiosyncratic investment distortion on the cost of investment and liquidity constraints (Miao et al. (2015b); Dong et al. (2018)). The bribery gifts (bubbly asset) can be transformed into the political capital in a bijective method. The government officials receive gifts and supply the political capital, and firms demand the political capital. The PC firms can relax their credit constraints and acquire liquidity by holding the political capital (building the political connection). The benefits firms gain is proportional to the strength of connection. With time-varying investment distortions, firms that want to invest in physical capital in the future have to hold liquid assets. Therefore, PC firms would demand the political capital as a liquid asset and it has a positive liquidity premium. We show the existence of political capital bubble when inspection and regulation of corruption is loose enough. In contrast, NPC firms cannot set up the connection or their connection is not effective enough. In our model, the political capital bubble offer extra liquidity to PC firms, which leads to inequality in physical capital

distribution between the two sectors. Meanwhile, it has a substitution effect with physical capital in helping firms to obtain financing, which means a crowd effect on the physical capital.

Almost immediately upon assuming power, president Xi Jinping started a list of anti-corruption campaigns and think it as one of China's basic policies. Although plenty of empirical articles have discuss its impact in micro level, there is a surprisingly limited number of macroeconomic analyses on this topic. To this end, we take a quantitative exercise based on our model. We find that when corruption is impeded, the bubble devalues with decreasing liquidity premium and the value of physical capital increases. As a result, the investment and capital flow from the PC sector to the NPC sector. In a sum, the anti-corruption policy alleviates the crowd effect of the political capital, decreases the inefficient overinvestment of PC firms, and increases the consumption, which raises the social welfare.

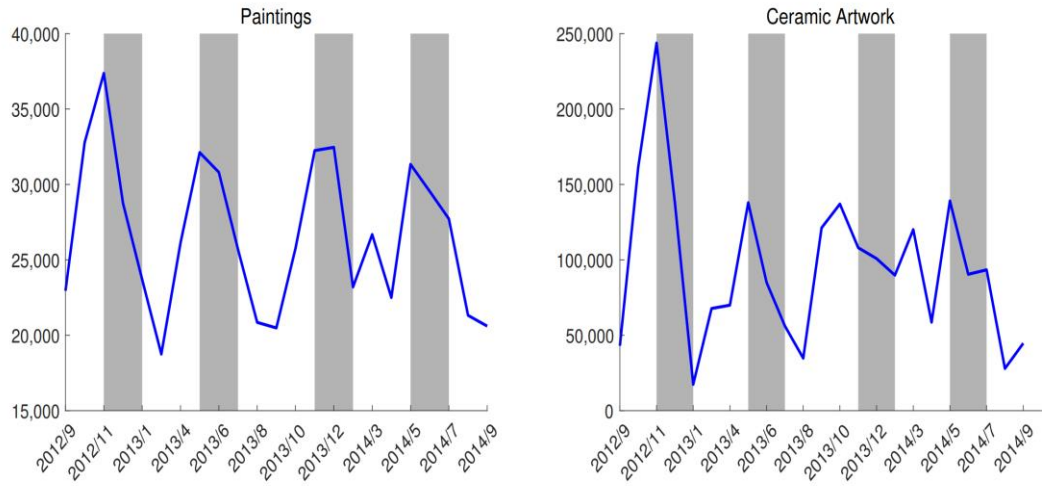


Figure 1: Boom-bust Cycles in the Painting and Ceramic Artwork Market

**Notes**: The gray areas indicate post anti-corruption policy periods. The y-axis of the left panel is the monthly average price per square chi of paintings and 1 square chi is equal to 1.196 square feet. The y-axis of the right one is the monthly average price of ceramic artwork. Data comes from Artron.net, which will be illustrated in section 2.3.

**Related Literature**: Our paper is largely motivated by the empirical corporate finance literature about corruption, financing and corporate performance. The early works include Li et al. (2008); Du and Girma (2010); Claessens et al. (2008); Cai et al. (2013). Recently, there are a list of research on Xi Jinping's anti-corruption campaigns. See Ding et al. (2017); Giannetti et al. (2017); Lin et al. (2016); Li et al. (2018); Hao et al. (2020), and Xu and Yano (2017). Most of those papers are empirical and focus on the firm level effect.

Our empirical section is closely related to Lan and Li (2018) and Qian and Wen (2015), who use event study to show the relationship between the price luxury goods and corruption. Compared with their paper, we use a unique and more individual level transaction data of the artwork, comprehensive and exogenous events, and a shorter event window, which decrease the estimation bias of anticorruption's impact on the asset bubble.

Generally speaking, our paper belongs to the literature on rational bubbles. The rational bubble theory consists of two branches of research. Firstly, the models using the overlapping generation framework include Tirole (1985); Farhi and Tirole (2012); Martin and Ventura (2012), and Chen and Wen (2014). Secondly, for infinite-horizon models, see Miao and Wang (2018); Wang and Wen (2012); Aoki and Nikolov (2015), and Miao et al. (2015a). See Miao (2014) and Martin and Ventura (2018) for comprehensive surveys on rational bubbles.

# 2. Empirical Findings

In this section, we first introduce the institutional background of corruption and proper gifts (bubbly assets) to build the political connection. We then use three exogenous anti-corruption events to identify the positive relationship between the corruption and the asset bubble.

## 2.1 Institutional Background and Descriptive Evidence

Developing connections is culturally and historically deep-rooted in China. The political connection is a normal part of doing business, and gifts play an important role in pleasing officials and setting up connections between officials and business people. The connections built by gifts mean extra values, for instance, relaxing firm's credit constraints, which leads to the formation of asset bubbles of gifts.

Corruption is a serious public concern in China. In modern Chinese history, corruption weakened Chiang Kai-shek's Kuomintang regime and brought support for Mao Zedong's Communist Party. But nowadays, the government's "public servants" impression is questioned by the public with frequent occurrence of corruption cases. As a threat to government image and economic growth, corruption would make the Party take the risk of losing support as Chiang did. Things changed since Xi Jinping became president. Xi officially assumed the title of the General Secretary of Communist Party of China (CPC) and Chairman of the Party Central Military Commission on November 14, 2012, at the conclusion of the Party's 18th National Congress. Concerned of the seriousness of corruption, Xi began a list of anti-corruption campaigns almost immediately upon assuming power.

The following four campaigns are important among Xi's anti-corruption fights and often chosen as exogenous events in a number of corporate finance literature about anti-corruption in China (e.g., Qian and Wen (2015); Lin et al. (2016); Ding et al. (2017); Giannetti et al. (2017); Li et al. (2018)). On December 4 2012, Xi started his first campaign with a policy document entitled the Eight-point Policy, which provides explicit rules concerning the behavior of officials such as bans on extravagant house purchases and state-funded banquets. More concrete actions of investigation and punishment about corruption arrived in 2013. On May 17 2013, the Central Commission for Discipline Inspection (CCDI), the Party's highest internal-control institution, announced that it would conduct several rounds of inspections. The inspection teams have unlimited power to investigate and interrogate officials involved in bribery without considering their levels.

On December 25 2013, the CPC published a five-year anti-corruption plan. The plan placed particular emphasis on corruption about bribe-taking, extravagance, and waste. The number of investigated officials is also unprecedented during a list of campaigns. More than 182,000 officials at various levels were arrested or investigated in 2013 alone. From June to August 2014, there was an earthquake for officials after the announcement of investigation for Su Rong (Vice-chairman of the National Committee of the Chinese People's Political Consultative Conference), Ling Zhengce, brother of Ling Jihua (Head of the United Front Work Department of the CPC Central Committee), and other six provincial officials in Shanxi Province. The investigation represents the collapse of top-level political and commercial clique, Xishan Society, which shows Xi's unexpected

abomination to the political connection.

We will measure the bursting of bubbles by observing the changes in artwork's (Chinese paintings and ceramic artwork) price during the anti-corruption. The reason is that artwork has a relatively stable fundamental value and is helpful in bribing the officials. Firstly, different from gifts like gold and housing, artwork tends to have a low value in use and require a strong ability to select, afford and appreciate, which makes them not popular among ordinary people. Therefore, the artwork's appreciating (fundamental) value is relatively stable during a short time. Secondly, with portable size, high value, and a sense of elegance and luxury, paintings and ceramic artwork are very proper gifts for the modern officials, who are artsy-fartsy and have enough energy to appreciate them. Another advantage is that officials can say the bribes are fake and cheap to mitigate their crimes when investigated. We can find a number of scandals of investigated officials at various levels about receiving the artwork when searching "雅贿" (elegant bribery) in Google or Baidu – China's most popular search engine.

In section 2.3, we will make further analysis on the burst of bubble by using a micro transaction dataset of paintings that variables associated with the fundamental value are controlled.

## 2.2 Event Description

In this subsection, we will list three exogenous anti-corruption campaigns and explain why they are surprising and significant enough for officials and business people. The events include Eight-Point Policy, the announcement of CCDI inspection, and investigation of Su Rong and Ling Zhengce. We then use these campaigns to conduct event studies to test the relationship between asset bubble and political connection.

**Eight-Point Policy** Xi started his first anti-corruption campaign with a policy document entitled the Eight-point Policy on December 12 2012. Each of its points provides explicit rules on the behaviors of officials. For example, one of them restrains officials from buying extravagant houses. All of the eight points are listed in appendix B. Two reasons made it unexpected and influential at that time. Firstly, the policy unusually specified detailed rules and had few inane slogans. Secondly, the anti-corruption objective was expressed clearly almost immediately after the initial announcement. Premier Li Keqiang promised, "zero tolerance to corrupt officials" and "to seriously punish any breach of the Eight-Point" (Lin, Morck, Yeung and Zhao, 2018). Individual provinces and State-owned enterprise (SOE) also quickly launched more detailed rules to show their advocation to this policy.

**CCDI Inspection** On May 17, 2013, CCDI announced that it would conduct several rounds of inspections. The inspection teams have unlimited power to investigate and interrogate officials involved in bribery without considering their levels. The teams would stay in inspected provinces for two months, collect information with local anti-graft agency's help and actively listen to suggestions from the public and retired officials. Although the list of inspected provinces was not published on May 17, it is quite clear that each province will be finally inspected. The fear of inspection would make officials more prudent and reduce the connection with private sectors a lot.

I**nvestigation of Su and Ling** An earthquake occurred for cliques of government officials because of the investigation of Su Rong and Ling Zhengce on June 14, 2014. Su was Secretary of Jiangxi Provincial Party Committee from 2007 to 2013 and Vice chairman of the National

Committee of the Chinese People's Political Consultative Conference (CPPCC) since 2013. Ling was Vice-Chairman of Shanxi Provincial CPPCC since 2008 and brother of Ling Jihua, Secretary of the Central Secretary and Minister of Central United Front. They were important members of Xishan Society, a top-level political and commercial clique. The event was an unexpected signal to root out a large corrupt clique. Ling Jihua and other 16 high-ranking officials of Xishan Society were also investigated after the event of Su Rong and Ling Zhengce. The Su-Ling event indicates Xi's zero-tolerance to corrupt cliques and determination to stop transactions between money and power. In this case, astonished officials would try to conceal the connection and keep cautious.

## 2.3 Heterogeneous Response to Anti-Corruption Shocks

This subsection describes my main empirical results. As mentioned in section 2.1, We use paintings as representative bubble assets and show that their prices decrease significantly after surprising anti-corruption campaigns. More precisely, we find that the response of prices is heterogeneous for paintings of different themes and painters because there is more depreciation on ones that are more popular as gifts. We use an event study method and a unique micro-transaction dataset of paintings to identify the political asset bubble.

We get daily Chinese painting transaction data of 32 leading cities from China's biggest antique transaction record website, Artron.net. There are about 12,000 transaction records of paintings during a month, which is a large number for the expensive Chinese paintings and can be thought of as a representative sample.

We compare the price changes before and after three exogenous events in 2.2. For each event, we compare 20 ex-ante days' prices with 15 ex-post days' prices.1 After controlling variables that determine the fundamental value, including authors, texture, images, and creative time, we can estimate the impact of anti-corruption campaigns on the bubble since the fundamental value is relatively changeless during that short time. The specified regression equation is as follows:

$$p_{t,s}^{i,j} = \alpha_1^s + \alpha_2 \times After_t + \alpha_3 \times A_j + \alpha_4 \times Z_t + \alpha_5 \times X_i + \varepsilon_{t,s}^{i,j} \qquad (1)$$

In the above equation, $p_{t,s}^{i,j}$ denotes the log price per square chi for painting i created, by author j at time t and in city s; $\alpha_1^s$ is the term for city fixed effect; $After_t$ is a zero-one dummy variable, which equals to 0 if the painting is sold before the event date and 1 after the event date; $A_j$ is painting's author; $Z_t$ denotes the month fixed effect, weekday effect and indicators to control the macroeconomic conditions; and $X_i$ indicates other individual characteristics, including the texture, way of framing, subject and content.

Table **1** summarizes the results of mentioned equation. Columns 1-3 respectively correspond to 3 anti-corruption campaigns in chronological order. Dec 2012 corresponds to Eight-Point Policy, May 2013, to CCDI Inspection and June 2014 to the investigation of officials. The estimations of After_t show that anti-corruption campaigns make the price of paintings decreases significantly. More specifically, the market takes a swift response to the event and decrease by about 20% on average within 15 days, which shows a positive relationship exists between political connection and asset bubble.

To test the existence of heterogeneous responses, we select paintings as subsamples that are created by renowned authors or sold in Beijing, China's political center, and replicate previous

regression. We set renowned authors as painters whose transaction volume ranks top 25% in the artron.net. Table **2** shows the results. Items in each row and column correspond to one estimation of After_t in the regression equation. Each row corresponds to an individual anti-corruption campaign and each row to a kind of sample. All in the column means that the sample contains paintings in all cities and Beijing for paintings transacted in Beijing. W and H respectively correspond to paintings by all authors and renowned authors. For example, the item in the second row and the second column corresponds to the estimation of After_t for CCDI inspection with a sample containing paintings sold in all cities and by renowned authors.

If officials cherish and are proud of boasting paintings by famous painters, prices of these paintings should decrease to a more significant degree after events, which is consistent with our results. Comparing columns "W" with "H", we can find that there exists a more considerable negative feedback on anti-corruption campaigns for paintings by renowned painters. In addition to the variation of quality, transaction places also make sense. Comparing columns "All" with "Beijing", we know that anti-corruption makes painting prices decrease more in Beijing than the whole country. The reason is that Beijing's role of political center contributes to a completer and more developed channel on using paintings to build political connections. As a result, the bubble to fundamental ratio is larger in Beijing's market that a bigger recession occurs when anti-corruption campaigns are launched.

Table **3** shows the impact of painting themes. Each row indicates the interaction term between Image and After. Image1-8 are a group of zero-one dummy variables and indicate different themes of paintings. For example, Image1 is equal to one when the theme is flowers. Table **4** lists the description of themes. Paintings about flowers and a feeling of wealth decrease more after anticorruption campaigns because they cater to modern Chinese officials' desire for wealth and other beautiful things. In a word, the more proper one asset is to build connections, the larger bubble forms, and prices decrease more after the events.

## 2.4 Robustness Check

In this section, we conduct three robustness checks. First, we use alternative event windows. Table **5** summarizes the results. Columns (1) to (3) correspond to an event window with 30 ex-ante and 25 ex-post days. Columns (4) to (6) correspond to an event window with 60 ex-ante and 40 ex-post days. The drop of prices is still significantly negative with a longer event window. Second, we use ceramic artwork, another bribery gifts to replicate regressions in table 1. We do not consider Eight-Point Policy due to a lack of data. Table **6** shows that ceramic artwork decreases more than paintings after anti-corruption campaigns, perhaps because of a higher value as gifts. Third, we conduct placebo tests in case of interference from other factors. Specifically, we move the whole event window forward for 30 days, set corresponding fake event dates, and replicate regressions in table 1 5000 times within a group of random subsamples. Figure **2** shows the distribution of estimation for After_t and the red lines are corresponding outcomes in table 1. Thus, there does not exist a significant drop in prices after fake events and proves the robustness of our results.

In summary, we find that political connection is closely linked to bubbles on the paintings and ceramic art markets. The more popular the asset is to build connections, the larger bubble forms. It is mentioning that the political bubble can also apply to a wide range of other gifts such as

housing, luxury watches and, vintage wines. After anti-corruption campaigns, bubble bursts and the political connection is broken, which leads to the reallocation of resources (e.g., credit reallocation from PC firms to NPC firms) and has a considerable influence on the whole economy. In later sections, we will model the relationship and discuss this question quantitatively.

Table 1: **Impact of Anti-corruption on Painting Prices**

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | Dec 2012 | May 2013 | Jun 2014 |
| After | -0.144** | -0.236*** | -0.360*** |
| | (0.057) | (0.043) | (0.029) |
| Controls | | | |
| Image of Paintings | Yes | Yes | Yes |
| Month FE | Yes | Yes | Yes |
| Weekday FE | Yes | Yes | Yes |
| City FE | Yes | Yes | Yes |
| Author FE | Yes | Yes | Yes |
| GDP Growth | Yes | Yes | Yes |
| Characteristics | Yes | Yes | Yes |
| Observations | 10,266 | 10,152 | 17,897 |
| Adjusted R-squared | 0.557 | 0.504 | 0.501 |

**Notes**: Columns 1-3 respectively corresponds to 3 anti-corruption campaigns in chronological order. Dec 2012 corresponds to Eight-Point Policy, May 2013 to CCDI Inspection and June 2014 to investigation of officials. The numbers in parentheses are robust standard errors. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 2: **Heterogeneity Analysis: Authors**

| Event Time | AllW | AllH | BeijingW | BeijingH |
|---|---|---|---|---|
| Dec 2012 | -0.144** | -0.267*** | -0.152** | -0.343*** |
| | (0.057) | (0.101) | (0.063) | (0.103) |
| May 2013 | -0.236*** | -0.308*** | -0.318*** | -0.346*** |
| | (0.043) | (0.067) | (0.059) | (0.082) |
| June 2014 | -0.360*** | -0.731*** | -0.570*** | -0.830*** |
| | (0.029) | (0.058) | (0.045) | (0.082) |

**Notes**: Results in each row and column corresponds to one estimation of After_t in the regression equation. Each row corresponds to an individual anti-corruption campaign and each row to a kind of sample. All in the column means that the sample contains paintings in all cities and Beijing for paintings transacted in Beijing. W and H respectively correspond to paintings by all authors and renowned authors. For example, the item in the second row and the second column corresponds to the estimation of After_t for CCDI inspection with a sample containing paintings sold in all cities and by renowned authors. The numbers in parentheses are robust standard errors. *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

Table 3: **Heterogeneity Analysis: Images**

| | (1) | (2) | (3) |
|---|---|---|---|
| VARIABLES | Dec 2012 | May 2013 | Jun 2014 |
| After*Image1 | -0.139** | 0.043 | -0.083* |
| | （0.065） | (0.069) | (0.050) |
| After*Image 2 | 0.136* | -0.288*** | -0.049 |
| | （0.079） | (0.090) | (0.062) |
| After*Image 3 | 0.015 | -0.043 | -0.091* |
| | （0.065） | (0.066) | (0.050) |
| After*Image4 | -0.010 | 0.134 | 0.000 |
| | （0.123） | (0.129) | (0.091) |
| After*Image5 | -0.112 | - 0.012 | -0.145 |
| | （0.115） | (0.126) | (0.096) |
| After*Image6 | -0.051 | -0.016 | -0.052 |
| | （0.073） | (0.080) | (0.057) |
| After*Image7 | -0.011 | 0.014 | -0.016 |
| | （0.049） | (0.052) | (0.037) |
| After*Image8 | 0.106 | -0.240* | -0.153* |
| | （0.132） | (0.129) | (0.093) |
| Observations | 10,266 | 10,152 | 17,897 |
| Adjusted R-squared | 0.557 | 0.504 | 0.501 |

**Notes**: Each row indicates the interaction term between Image and After. Image1-8 are a group of zero-one dummy variable and indicate different themes of paintings. For example, image1 is equal to one if the theme of painting is flowers. The numbers in parentheses are robust standard errors. The levels of significance are denoted as *** p < 0.01, ** p < 0.05, and * p < 0.1. Other controls are same with table **1**.

Table 4: **Themes of Paintings**

| Images | Themes |
|---|---|
| Image1 | Flowers |
| Image2 | Trees |
| Image3 | Animals |
| Image4 | Fruits and Vegetables |
| Image5 | Chinese Mythologies |
| Image6 | Seclusion |
| Image7 | Mountains and Rivers |
| Image8 | Wealth |

Table 5: **Alternative Event Windows**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| VARIABLES | Dec 2012 | May 2013 | Jun 2014 | Dec 2012 | May 2013 | Jun 2014 |
| After | -0.413*** | -0.108*** | -0.288*** | -0.447*** | -0.159** | -0.241*** |
| | (0.056) | (0.037) | (0.027) | (0.052) | (0.032) | (0.025) |
| Controls | | | | | | |
| Image | Y | Y | Y | Y | Y | Y |
| Month FE | Y | Y | Y | Y | Y | Y |
| Weekday | Y | Y | Y | Y | Y | Y |
| City FE | Y | Y | Y | Y | Y | Y |
| Author FE | Y | Y | Y | Y | Y | Y |
| ΔGDP | Y | Y | Y | Y | Y | Y |
| | Y | Y | Y | Y | Y | Y |
| Characteristics | | | | | | |
| Observations | 13,980 | 14,717 | 22,932 | 23,152 | 26,513 | 32,817 |
| Adjusted $R^2$ | 0.528 | 0.519 | 0.512 | 0.537 | 0.491 | 0.501 |

**Notes**: Columns (1) to (3) correspond to an event window with 30 ex-ante and 25 ex-post days. Columns (4) to (6) an event window with 60 ex-ante and 40 ex-post days. The numbers in parentheses are robust standard errors. *** p < 0.01, ** p < 0.05, and * p < 0.1.

Table 6: **Impact of Anti-Corruption on Ceramic Artwork Prices**

| | (1) | (2) |
|---|---|---|
| VARIABLES | May 2013 | Jun 2014 |
| After | -0.591** | -0.565*** |
| | (0.235) | (0.159) |
| Controls | | |
| Size | Y | Y |
| Type | Y | Y |
| Weekday FE | Y | Y |
| City FE | Y | Y |
| GDP Growth | Y | U |
| Observations | 549 | 869 |
| Adjusted R-squared | 0.398 | 0.270 |

**Notes**: Columns (1) to (2) correspond to the outcome of the ceramic artwork. Due to lack of sample, we ignore the Dec 2012 event. The numbers in parentheses are robust standard errors. *** p < 0.01, ** p < 0.05, and * p < 0.1.

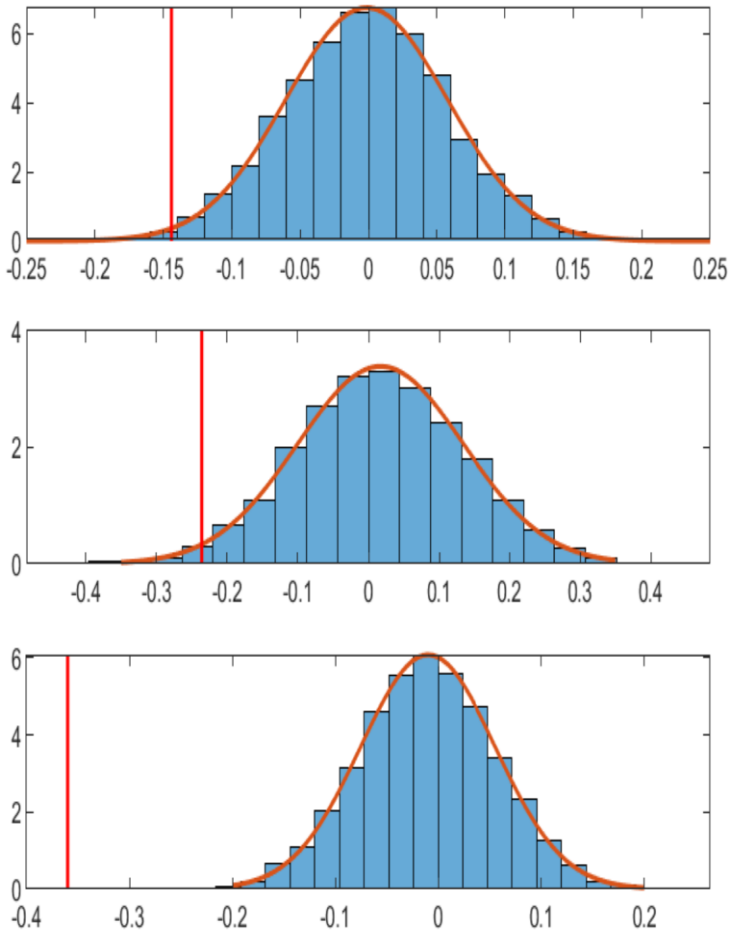


Figure 2: Placebo Tests

**Notes**: We move the whole event window forward for 30 days, set corresponding fake event dates, and replicate regressions in table 1 5000 times within a group of random subsamples. Figure 2 shows the distribution of estimation for $After_t$ and three red lines are corresponding outcomes in table 1.

# 3. Model

In this section, we construct a model for the bubble to make sense of the empirical relationship between corruption and the asset bubble. We will also conduct a quantitative exercise to evaluate the aggregate impacts of the anti-corruption policy.

Consider an infinite-horizon industry dynamic model. The time is discrete with t = 0, 1, 2, …, We consider an industry with two sectors--a political connected (PC) sector (sector s) and a nonpolitical connected (NPC) sector (sector p). There is a unit measure of firms indexed by j∈[0, 1] in each sector. We will describe and characterize industry dynamics with capital accumulation. Firms use physical capital and labor to produce consumption and investment goods. Firms accumulate physical capital and suffer financial frictions. To model the variations of investment efficiency, we assume that each period firms receive idiosyncratic investment efficiency shocks. In a sum, firms in different sectors use same approach to hiring capital and labor but face different credit constraints.

## 3.1 Firms in the PC Sector

In each period t, a typical PC firm j hires labor $n_{jt}^s$ and accumulates physical capital $k_{jt}^s$ to produce final goods $y_{jt}^s$ . Each firm employs the same Cobb-Douglas production technology, $y_{jt}^s = a_t^s(k_{jt}^s)^\alpha(n_{jt}^s)^{1-\alpha}$, where α∈(0,1) is the capital share and $a_t^s$ measures the productivity. The firm's labor demand is essentially a static decision. Firm *j* chooses optimal labor $n_{jt}^s$ that the labor demand function is given by $W_t = (1-\alpha)a_t^s(k_{jt}^s/n_{jt}^s)^\alpha$. The revenue net of labor cost is linear in $k_{jt}^s$, which satisfies $a_t^s(k_{jt}^s)^\alpha(n_{jt}^s)^{1-\alpha} - W_t n_{jt}^s = R_t^s n_{jt}^s$, where $R_t^s = \alpha a_t^s(\frac{(1-\alpha)a_t^s}{W_t})^{\frac{1-\alpha}{\alpha}}$ is the marginal rate of return to capital. The physical capital $k_{jt}^s$ accumulates according to the following law of motion

$$k_{j,t+1}^s = (1-\delta)k_{jt}^s + \varepsilon_{jt}k_{jt}^s \qquad (2)$$

where $\delta$∈(0, 1) is the depreciation rate; $\varepsilon_{jt}$ is the idiosyncratic investment efficiency shock following CDF $\mathbf{F}(\varepsilon)$ on the support $(\varepsilon_{min}, \varepsilon_{max})$. For the tractability, we assume $\varepsilon_{jt}$ is i.i.d across firms and over time. Besides, firm j is assumed to make investment decision after observing its individual shock $\varepsilon_{jt}$. We also assume investment is subject to irreversibility constraint.

$$i_{jt}^s \geq 0 \qquad (3)$$

We introduce bubbly goods that is used to bribe the government officials into the model. Let $p_t$ denote the price of bubbly goods that the firm can obtain from the market, and $x_{jt}$ the quantity of bubbly goods demanded by firm j. Here the bubbly assets can be the artwork or luxury goods that is used to bribe the government officials. The flow of funds constraint for firm j is given by

$$d_{jt}^s + i_{jt}^s + p_t x_{jt} + m_t c(p_t x_{jt}) + l_{jt}^s = R_t^s k_{jt}^s + \frac{l_{jt+1}^s}{R_{ft}} \quad (4)$$

where $d_{jt}^s$ is the dividend; $i_{jt}^s$ is the external debt and $R_{ft}$ is the corresponding interest rate; the term $p_t x_{jt}$ is the expenditure for bribing; $m_t c(p_t x_{jt})$ indicates the additional cost that the firm may pay due to the punishment of bribing, $m_t$ is the probability that the bribe will be investigated by the government. For $c(p_t x_{jt})$, we assume

$$c(p_t x_{jt}) = \zeta p_t x_{jt} \quad (5)$$

We assume that the bubbly good helps to build up connection with government officials and accumulate the political capital $b_{jt}$. The accumulation of political capital follows

$$b_{jt+1} = (1 - \delta_b) b_{jt} + z_t \quad (6)$$

where $z_t$ is the new built political capital. Let *Pt* denote the relative price of political capital. Then we assume

$$z_{jt} = \frac{\xi p_t x_{jt}}{P_t} \quad (7)$$

where $\xi > 0$ indicates the efficiency that the bribe can be transformed to political capital. Last equation indicates that one unit of expenditure on the bribe can be transformed to $\xi/P_t$ unit of political capital. Mathematically, the political capital here plays a role of bubble.

As emphasized by Santos and Woodford (1997) and Miao and Wang (2018), a necessary condition to guarantee the existence of rational bubbles (political capital) is that economic agents are subject to financial market frictions. To this end, we assume that firms are facing the following financial constraints:

(i) *equity financing constraint* (see Jermann and Quadrini (2012), among others) such that

$$d_{jt}^s \geq 0 \quad (8)$$

i.e., firms are not allowed to borrow from shareholders,

(ii) *debt financing constraint* (see Kiyotaki and Moore (1997), among others) such that

$$\frac{l_{jt+1}^s}{R_{ft}} \leq \theta_k (1 - \delta) Q_t^s k_{jt}^s + \theta_b (1 - \delta_b) P_t b_{jt} \quad (9)$$

where the parameter $\theta_k$ reflects the tightness of financial constraint; $\theta_b (1 - \delta_b) P_t b_{jt}$ reflects

the fact that the political capital can assist the firm to obtain more credit from the bank. $Q_t^s$ the market value of installed capital will be defined later. We use the parameter $\theta_k$ to capture the financial constraint of the firm. A smaller $\theta_k$ indicates a tighter constraint. In addition, we impose a non-negative constraint on firm's expenditure on the bribe,

$$x_{jt} \geq 0 \qquad (10)$$

## 3.2 Firms in the NPC Sector

We introduce heterogeneous NPC firms that share same approach to hiring capital and labor as PC firms but obtain financing in a different method. In each period, a typical firm j hires labor $n_{jt}^p$ and accumulates physical capital $k_{jt}^p$ to produce final goods $y_{jt}^p$. The firm also employs the Cobb-Douglas production technology $y_{jt}^p = a_t^p (k_{jt}^p)^\alpha (n_{jt}^p)^{1-\alpha}$, where $a_t^p$ measures the productivity of the NPC sector. The firm's labor demand is $W_t = (1-\alpha)a_t^p (k_{jt}^p / n_{jt}^p)^\alpha$. The revenue net of labor cost is also linear in $k_{jt}^p$, which satisfies $y_{jt}^p - W_t n_{jt}^p = R_t^p k_{jt}^p$, where $R_t^p = \alpha a_t^p \left(\frac{(1-\alpha)a_t^p}{W_t}\right)^{\frac{1-\alpha}{\alpha}}$. The evolution of physical capital is given by

$$k_{j,t+1}^p = (1-\delta)k_{jt}^p + \varepsilon_{jt} k_{jt}^p \qquad (11)$$

The NPC firm's investment is irreversible,

$$i_{jt}^p \geq 0 \qquad (12)$$

We assume that NPC firms cannot find methods to bribe officials or use the political capital to get financing. Thus, they would not hold the bubbly goods to build the connection. They might not even know which asset caters to officials' tastes. In this case, the budget constraint is given by

$$d_{jt}^p + i_{jt}^p + l_{jt}^p = R_t^p k_{jt}^p + \frac{l_{jt+1}^p}{R_{ft}} \qquad (13)$$

where $d_{jt}^p$ is the dividend; $l_{jt}^p$ is the external debt and $R_{ft}$ is the corresponding interest rate. The firm also faces the following debt financial constraint:

(i) *equity financing constraint*

$$d_{jt}^p \geq 0 \qquad (14)$$

(ii) *debt financing constraint*

$$\frac{l_{jt+1}^p}{R_{ft}} \leq \Psi_t \qquad (15)$$

where $\Psi_t$ denotes the maximal amount of loans open to NPC firms in period t. We assume that $\Psi_t \leq \theta_k (1-\delta) Q_t^p k_{jt}^p$, which reflects the difficulty of obtaining a loan for NPC firms.

## 3.3 Household

We introduce a representative household in this economy. The household chooses consumption, $C_t$, and stock holdings for each firm j in sector n, $s_{jt+1}^n$, to maximize lifetime utility The household's labor supply is fixed to be one. The budget constraint is given by

$$C_t + \sum_{n=\{s,p\}} \int_0^1 s_{jt+1}^n \left(V_{jt}^n - d_{jt}^n\right) dj = W_t + \sum_{n=\{s,p\}} \int_0^1 s_{jt}^n V_{jt}^n dj - T_t \qquad (16)$$

where $d_{jt}^n$ denotes the dividend distributed from the firm *j* in sector *n*, $W_t$ is the wage, and $T_t$ represents lump-sum taxes satisfying $T_t = \sum_{n=\{s,p\}} \int_0^1 (\varepsilon_{jt} - 1) i_{jt}^n \, dj$. Note that we introduce this lumpsum tax, $T_t$, to offset the impact of investment efficiency, $\varepsilon_{jt}$, on the household side.

Let $\Lambda_t$ denote the Lagrange multiplier for the budget constraint (16). The optimal consumption decision implies $\Lambda_t = 1/C_t$. The optimal condition for the equity holding, $s_{jt+1}^n$, is given by

$$V_{jt}^n = d_{jt}^n + \beta \boldsymbol{E_t} \frac{\Lambda_{t+1}}{\Lambda_t} V_{jt+1}^n, n = s, p \qquad (17)$$

where $\Lambda_{t+1}/\Lambda_t$ denotes the stochastic discount factor. The equation (17) essentially describes the recursive process of the firm's value function in sector n.

## 3.4 Government Officials

We assume there is a continuum government official who provides political capital to the PC firms. The cost function of producing new political capital, $\Gamma(z)$, satisfies: $\Gamma(0) = \Gamma'(0) = 0$, $\Gamma'(.) > 0$ and $\Gamma''(.) > 0$. We specify $\Gamma = \frac{1}{1+\sigma}(z_{jt})^{1+\sigma}$. We assume that regardless being investigated, the cost is always paid. With probability $1 - m_t$ the official will not be investigated, so the revenue in this case is $p_t x_{jt}$. With probability $m_t$, the official will be investigated. In this case, the punishment is assumed to be linear in the total value of bribe he obtained, i.e., $\chi p_t x_{jt}$. So, the total expected net benefits the entrepreneur obtains satisfies

$$\Pi_t = (1 - m_t) p_t x_{jt} - m_t \chi p_t x_{jt} - \frac{1}{1+\sigma} \left(z_{jt}\right)^{1+\sigma} \qquad (18)$$

where $z_{jt} = \frac{\xi p_t x_{jt}}{P_t}$. The optimal decision implies

$$z_{jt} = \{[1 - m_t(1+\chi)]\frac{P_t}{\xi}\}^{\frac{1}{\sigma}} \quad (19)$$

which does not depend on the individual states. Define the aggregate political capital as $z_t = \int z_{jt}dj$. So, we must have $z_{jt} = z_t = \int z_{jt}dj$ . The optimal political capital that the official provides is increasing in the relative price of political capital $P_t$ and decreasing in the probability of being investigated $m_t$. Given the above optimization, the total value of political capital that each individual government official created is

$$P_t z_t = [\frac{1 - m_t(1+\chi)}{\xi}]^{\frac{1}{\sigma}} P_t^{1+\sigma} \quad (20)$$

## 3.5 Competitive Equilibrium

A competitive equilibrium consists of a sequence of quantities $\{i_{jt}^n, n_{jt}^n, k_{jt+1}^n, b_{jt+1}, z_{jt}, x_{jt}\}_{t\geq 0}$, n=s, p, and a sequence of prices $\{W_t, V_{jt}^n, P_t, p_t\}_{t\geq 0}$ for j∈[0, 1], such that: (i) Given prices $\{W_t, P_t, p_t\}_{t\geq 0}$, the sequence of quantities $\{i_{jt}^s, n_{jt}^s, k_{jt+1}^s, b_{jt+1}, z_{jt}, x_{jt}\}_{t\geq 0}$ solves each PC firm j's problem, subject to the constraints (2) to (10); (ii) Given the price $\{P_t, p_t\}_{t\geq 0}$, he government official solves its profit optimization problem; (iii) Given prices $W_t$, the NPC firms make decisions on $\{i_{jt}^p, n_{jt}^p, k_{jt+1}^p\}_{t\geq 0}$ to maximizes its profit subject to the constraints (11) to (15); (iv) Labor market, bubbly asset market and goods market clear: $N_t = N_t^s + N_t^p = \sum_{n=\{s,p\}} \int_0^1 n_{jt}^n dj$ for j∈[0, 1], where we assume the bubbly good (luxury goods) has fixed supply of 1.

From the market clearing conditions, the price of luxury goods $p_t$ is

$$p_t = \frac{P_t z_t}{\xi} = [1 - m_t(1+\chi)]^{\frac{1}{\sigma}} (\frac{P_t}{\xi})^{1+\frac{1}{\sigma}} \quad (21)$$

# 4. Characterization

We now characterize the decision rule of the individual firm j∈[0, 1] in sector *n*. Since firm j's problem (17) is essentially a linear dynamic programming, we can characterize the decision rules in an analytical form.

To make the problem of PC firms more compact, we substitute the $x_{jt}$ with $z_{jt}$, obtaining

$$x_{jt} = \frac{P_t z_{jt}}{\xi p_t} \tag{22}$$

The flow of funds constraint can be expressed as

$$d_{jt}^d + i_{jt}^s + \left(\frac{1+m_t\zeta}{\xi}\right) P_t\left[b_{jt+1} - (1-\delta_b)b_{jt}\right] + l_{jt}^s = R_t^s k_{jt}^s + \frac{l_{jt+1}^s}{R_{ft}} \tag{23}$$

The non-negative constraint (10) is equivalent to

$$b_{jt+1} \geq (1-\delta_b)b_{jt} \tag{24}$$

Following proposition characterize the optimal investment decision of the PC firm.

**Proposition 1** *Denote Qs t as PC firm's Tobin's Q. Then the optimal decision rule for firm j's investment follows trigger strategy*

$$i_{jt}^s = \begin{cases} R_t^s k_{jt}^s + \theta_k(1-\delta)Q_t^s k_{jt}^s + \theta_b(1-\delta_b)P_t b_{jt} - l_{jt}^s, & if\ \varepsilon_{jt} > \varepsilon_{st}^* \\ 0, & if\ \varepsilon_{jt} \leq \varepsilon_{st}^* \end{cases} \tag{25}$$

*where* $\varepsilon_{st}^* = 1/Q_t^s$ *is independent with idiosyncratic states, and the Euler equations for PC firm's Tobin's Q, for the price of political capital, and the interest rate are respectively given by*

$$Q_t^s = \beta E_t \frac{\Lambda_{t+1}}{\Lambda_t}\{R_{t+1}^s[1+\Phi(\varepsilon_{st+1}^*)] + (1-\delta)Q_{t+1}^s[1+\theta_k\Phi(\varepsilon_{st+1}^*)]\} \tag{26}$$

$$\left(\frac{1+m_t\zeta}{\xi}\right)P_t = \beta(1-\delta_b)E_t\frac{\Lambda_{t+1}}{\Lambda_t}\left[\left(\frac{1+m_{t+1}\zeta}{\xi}\right) + \theta_b\Phi(\varepsilon_{st+1}^*)\right]P_{t+1} \tag{27}$$

*where* $\Phi(\varepsilon^*)$ *captures the liquidity premium of each unit of cash flow, satisfying*

$$\Phi(\varepsilon^*) = \int_{\varepsilon_{min}}^{\varepsilon_{max}} \max\{\frac{\varepsilon}{\varepsilon^*} - 1, 0\}\, d\boldsymbol{F}(\varepsilon) > 0 \tag{29}$$

The intuition behind Proposition 1 is as below. To start with, the marginal benefit and the marginal cost of investing in physical capital is respectively given by $Q_t^s\varepsilon_{jt}$ and 1. So, firm *j* will

invest if and only if $Q_t^s \varepsilon_{jt} \geq 1$ or equivalently $\varepsilon_{jt} \geq \varepsilon_{st}^* \equiv 1/Q_t^s$. Given this trigger strategy, firm's investment has an additional real-option value 1 + max $\{\frac{\varepsilon_{jt}}{\varepsilon_{st}^*}$ -1, 0$\}$. As a result, the expected real-option value of firm's investment (or the liquidity premium) is represented by (29). Notice that the cutoff of the idiosyncratic investment efficiency shock indicates the average investment efficiency of firms.

Since the production function is constant return to scale, (25) indicates that firm's optimal investment decision follows a trigger strategy: firm will either invest by fully utilizing its liquidity (revenue from production plus external funds from the bank loan) or invest nothing, depending on the realization of investment efficiency $\varepsilon_{jt}$. Moreover, since $\varepsilon_{jt}$ is i.i.d across firms and over time, and Tobin's Q depends on firm's expected capital gain in next period, the cutoff $\varepsilon_{st}^*$ is independent with firm's idiosyncratic states.

The equation (26) is the Euler equation for Tobin's Q. The left-hand-side (L.H.S) of this equation is the market value of the additional unit of the installed physical capital. The right-hand-side (R.H.S) is the expected capital gain of one unit of newly installed capital. Specifically, the R.H.S consists of two parts: (i) one unit of newly installed capital will deliver $R_{t+1}^s$ units of net gain in the next period $t$ + 1 with market value $R_{t+1}^s$ (1 + $\Phi_{t+1}$), where $\Phi_{t+1}$ > 0 denotes the real-option value of real investment, (ii) it also has a residual market value (1 - $\delta$) $Q_{t+1}^s$ after depreciation in $t$ + 1, and (iii) in next period it can be used as collateral goods. The no-arbitrage condition requires that the L.H.S equates the R.H.S. Since $\varepsilon_{st}^*$ = $1/Q_t^s$, Euler equation (26) determines the equilibrium Tobin's Q.

Since the liquidity premium $\Phi(\varepsilon_{st}^*)$ is greater than 0, the financially-constrained firms have the incentive to self-insure themselves against idiosyncratic shocks by bribing the officers to mitigate their financial constraint. Specifically, the equation (27) is the Euler equation describing the demand for political capitals. The L.H.S is the marginal cost of accumulating one unit of political capital for the firm, which is measured by the cost of bribe (or luxury goods), $\left(\frac{1+m_t\zeta}{\xi}\right)P_t$. The R.H.S is the expected gain from holding one unit of political capital in the next period. For a political capital, the total collateral value after depreciation is $\theta_b(1-\delta_b)$. Therefore, the gain of holding it in the next period can be formulated as $\left(\frac{1+m_{t+1}\zeta}{\xi}\right)P_{t+1} + \theta_b(1-\delta_b)$. Besides, as the political capital can provide liquidity to finance physical capitals, the real-option value (or liquidity premium), $\Phi_{t+1}$, also emerges in (27).

Similar to PC firms, the NPC firm takes the following trigger strategy to make investment.

**Proposition 2** *Denote $Q_t^p$ as NPC firm's Tobin's Q. Then the optimal decision rule for firm j's investment follows trigger strategy*

$$i_{jt}^p = \begin{cases} R_t^p k_{jt}^p + \Psi_t - l_{jt}^p, & if\ \varepsilon_{jt} > \varepsilon_{pt}^* \\ 0, & if\ \varepsilon_{jt} \leq \varepsilon_{pt}^* \end{cases} \quad (30)$$

*where* $\varepsilon_{pt}^{*} \equiv 1/Q_t^p$ *is independent with idiosyncratic states, and the Euler equations for NPC firm's Tobin's Q is given by*

$$Q_t^p = \beta E_t \frac{\Lambda_{t+1}}{\Lambda_t}\{R_{t+1}^p[1+\Phi(\varepsilon_{pt+1}^{*})] + (1-\delta)Q_{t+1}^p\} \qquad (31)$$

*where* $\Phi(\varepsilon^{*})$ *captures the liquidity premium of each unit of cash flow, satisfying (29).*

The difference on the investment and debt between PC and NPC comes from credit constraints. The equation (30) shows that NPC firms follows a similar investment trigger strategy as PC firms. The equation (31) reflects the fact that the value of physical capital cannot have a large effect on the loans because NPC firms face a tighter debt financing constraint (15).

## 4.1 Aggregation and General Equilibrium

The full dynamic system can be summarized by the following proposition.

**Proposition 3** *Given the investigation probability of corruption mt ,and the maximal amount of loan open to NPC firms* $\Psi_t$*, the general equilibrium paths of the model economy are described by 17 aggregate variables,* $\{Q_t^n, P_t, p_t, Y_t, R_t^n, \varepsilon_{nt}^{*}, z_t, B_t, I_t^n, K_t^n, N_t^n, W_t\ n = s,p\}_{t\geq 0}$ *, which are governed by the following dynamic system:*

$$Q_t^s = \beta E_t \frac{\Lambda_{t+1}}{\Lambda_t}\{R_{t+1}^s[1+\Phi(\varepsilon_{st+1}^{*})] + (1-\delta)Q_{t+1}^s[1+\theta_k\Phi(\varepsilon_{st+1}^{*})]\} \qquad (32)$$

$$\left(\frac{1+m_t\zeta}{\xi}\right)P_t = \beta(1-\delta_b)E_t\frac{\Lambda_{t+1}}{\Lambda_t}\left[\left(\frac{1+m_{t+1}\zeta}{\xi}\right)P_{t+1} + \theta_b(1-\delta_b)\Phi(\varepsilon_{st+1}^{*})\right]P_{t+1} \qquad (33)$$

$$Q_t^p = \beta E_t \frac{\Lambda_{t+1}}{\Lambda_t}\{R_{t+1}^p[1+\Phi(\varepsilon_{pt+1}^{*})] + (1-\delta)Q_{t+1}^p\} \qquad (34)$$

$$Y_t = \sum_{n=\{s,p\}} a_t^n (K_t^n)^{\alpha}(N_t^n)^{1-\alpha} \qquad (35)$$

$$R_t^n = \alpha a_t^n \left(\frac{K_t^n}{N_t^n}\right)^{\alpha}, n = s,p \qquad (36)$$

$$Y_t = C_t + I_t^s + I_t^p \qquad (37)$$

$$Q_t^n = \frac{1}{\varepsilon_{nt}^{*}}, n = s,p \qquad (38)$$

$$B_{t+1} = (1-\delta_b)B_t + z_t \tag{39}$$

$$z_t = \{[1 - m_t(1+\chi)]\frac{P_t}{\xi}\}^{\frac{1}{\sigma}} \tag{40}$$

$$I_t^s = [R_t^s K_t^s + \theta_k(1-\delta)Q_t^s K_t^s + (1-\delta_b)B_t P_t][1 - \boldsymbol{F}(\varepsilon_{st}^*)]E(\varepsilon|\varepsilon \geq \varepsilon_{st}^*) \tag{41}$$

$$K_{t+1}^n = (1-\delta)K_t^n + I_t^n \quad n = s,p \tag{42}$$

$$I_t^p = \left[R_t^p K_t^p + \Psi_t\right]\left[1 - \boldsymbol{F}\left(\varepsilon_{pt}^*\right)\right]E\left(\varepsilon\middle|\varepsilon \geq \varepsilon_{pt}^*\right) \tag{43}$$

$$W_t = (1-\alpha)a_t^n\left(\frac{K_t^n}{N_t^n}\right)^{\alpha}, n = s,p, N_t^s + N_t^p = 1 \tag{44}$$

$$p_t = [1 - m_t(1+\chi)]^{\frac{1}{\sigma}}(\frac{P_t}{\xi})^{1+\frac{1}{\sigma}} \tag{45}$$

Equation (32), (33) and (34) are Euler equation for PC firm's physical capital, NPC firm's physical capital and political assets, respectively. (35) is the aggregate production function. (36) is derived from the definition of capital return $R_t^n$. (38) describes the definition of the cutoff $\varepsilon_{nt}^*$. (39) and (42) describe the law of motion of political capital and physical capital, respectively. (40) describes the supply curve of new political capital. Aggregating the individual investment decision in (25) and (30) correspondingly yields the aggregate investment (41) and (43). These equations manifest that the political capital may affect the aggregate investment through the *intensive margin* (the first term in the R.H.S), and the *extensive margin* (the second term in the R.H.S). Last equation indicates the relationship between the price of luxury goods and the price of political capital.

## 4.2 Stationary Equilibrium

For the model with asset bubble (political capital), it is common that there may exist multiple equilibria (e.g., Wang and Wen (2012); Miao and Wang (2018)): (i) fundamental (bubbleless) equilibrium with $P = 0$, and (ii) bubbly equilibrium with $P > 0$. Notice that, since the price of luxury goods $p_t$ is strictly increasing in $P_t$, the existence condition for bubble (political capital) is equivalent to the existence condition for the luxury goods. In this section, we aim to characterize the conditions under which bubbly equilibrium can be supported. Let $\varepsilon_{st}^*$ denote the PC firm's cutoff of investment efficiency shock. From the Euler equation for the physical capital (32) and the definition of cutoff (38), we can express the PC firm's marginal rate of return to capital $R_s$ as a function of the cutoff.

We now discuss the existence conditions and the steady-state properties for the bubbly

equilibria, i.e., the value of political capital is positive. To start with, from (41) we can express the value of political capital to physical capital ratio as

$$\frac{BP}{K_s} = \max\left\{\frac{\Delta(\varepsilon_s^*)}{(1-\delta_b)\theta_b}, 0\right\} \tag{46}$$

where $\Delta(\varepsilon_s^*)$ is defined as

$$\Delta(\varepsilon_s^*) = \frac{\delta}{[1-\boldsymbol{F}(\varepsilon_s^*)]E(\varepsilon|\varepsilon \geq \varepsilon_s^*)} - R_s - \theta_k(1-\delta)Q_s \tag{47}$$

which measures the gap between investment demand and internal liquidity. Thereby, the existence of bubbly equilibrium depends on the value of $\Delta(\varepsilon_s^*)$. The intuition is straightforward. The first term in $\Delta(\varepsilon_s^*)$, $\frac{\delta}{[1-\boldsymbol{F}(\varepsilon_s^*)]E(\varepsilon|\varepsilon \geq \varepsilon_s^*)}$, indicates the total amount of investment that needs to be input for one unit of installed capital. The second term in $\Delta(\varepsilon_s^*)$, $R_s$, is the internal fund that the firm can obtain from one unit of installed capital in the production. The last term in $\Delta(\varepsilon_s^*)$, $\theta_k(1-\delta)Q_s$, is the external fund that the firm can obtain from on unit of installed capital. The difference of these terms, $\Delta(\varepsilon_s^*)$, reflects the extra liquidity that needs to be financed through the political capital. Moreover, it is straightforward to show that $\Delta(\varepsilon_s^*)$ increases with the cutoff $\varepsilon_s^*$. Therefore, whether the term $\Delta(\varepsilon_s^*)$ is equal to or greater than zero provides the existence condition of the bubbly equilibria (i.e., the value of political capital in the equilibrium is positive). In the following paragraph, we show the positive relationship between $\theta_b$ and $\varepsilon_s^*$. In this case, anti-corruption policy would decrease the value of $\theta_b$ and impede the formation of bubble.

For the bubbly equilibrium, (33) implies that the cutoff is determined by

$$\Phi(\varepsilon_s^*) = \left[\frac{1}{\beta(1-\delta_b)} - 1\right]\frac{1+m\zeta}{\xi\theta_b} \tag{48}$$

As $\Phi(\varepsilon_s^*)$ decreases with $\varepsilon_s^*$, last equation implies that $\varepsilon_s^*$ strictly increases with the effectiveness of political capital $\theta_b$. The intuition is that the lower $\theta_b$ after the implement of anti-corruption policies tends to reduce the supply and demand for the political capital. As a result, the average investment efficiency is deteriorated since less liquidity can be obtained through the political connection.

# 5. Quantitative Exercise

We now use our production economy model to carry out a quantitative analysis of (i) conditions for the existence of asset bubble (political capital), (ii) the steady-impact of anti-corruption policy on bubbles and the real economy, (iii) the dynamic impact of anti-corruption policy.

Consistent with the related literature, we calibrate the characters as follows. The discount rate $\beta$ is set to be 0.98 and the depreciation rate of physical capital $\delta$ and political capital $\delta_b$ is set to be 0.05. We set the capital share in the production function $\alpha$ to be 0.3 and that investment efficiency $\varepsilon$ follows Pareto distributions with CDF=$1-(\frac{\varepsilon}{\varepsilon_{\min}})^{-\eta}$. To standardize the expectation of $\varepsilon$ to be 1, i.e., $E(\varepsilon)=1$, we must have $\varepsilon_{min} = 1 - 1/\eta$.

Without loss of generality, we specify the parameter of credit constraint $\theta_k$ to be 0.3 and the transformation efficiency from bribe to political capital $\xi$ to be 3. The penalty parameters of corrupt bureaucrats and firms, $\chi$ and $\zeta$ are both set to be 0.6, which is consistent with the fact that punishment is often lower than transaction price of bribery goods because it is difficult to determine the market value of bribery goods like paintings and calligraphy and those charged can resort to sophistry easily.

## 5.1 Bubbly Steady State

We first discuss the feasible set of the probability of investigation $m$ and the efficiency of political capital $\theta_b$ for the existence of a bubbly equilibrium. Figure 3 plots the feasible combinations of values of $m$ and $\theta_b$ that guarantee the existence of political capital bubble. The area above the curve is the bubbly equilibrium. The envelope of the feasible set shows that the value for $m$, and $\theta_b$ have a positive relationship, which means that the larger of effect of bubble on relaxing the credit constraints compensate for the loss from the higher probability of investigation so that the bubble exists. Before further analysis, we make more explanation about the parameter $\theta_b$. In the current Chinese political system, the value of $\theta_b$ depends on at least two factors, the magnitude of power and internal power struggle. There exist different political cliques in one sector and they compete intensely with each other. During the fierce political struggles, they achieve a delicate balance to decide parameter $\theta_b$, the efficiency of political connection to relax the credit constraints.

**Impact of Anti-Corruption Policy in the Long Run** As Figure 4 shows that, tightening corruption constraints, i.e. $\theta_b$ is smaller, will have an side effect on the demand side of bribery

goods, because a smaller $\theta_b$ means that bribery is not a useful channel to mitigate credit constraint problems and acquire liquidity in the long run. Then PC firms will not have an incentive to bribe and the market of bribery goods shrinks and prices go down in a similar way. At the same,

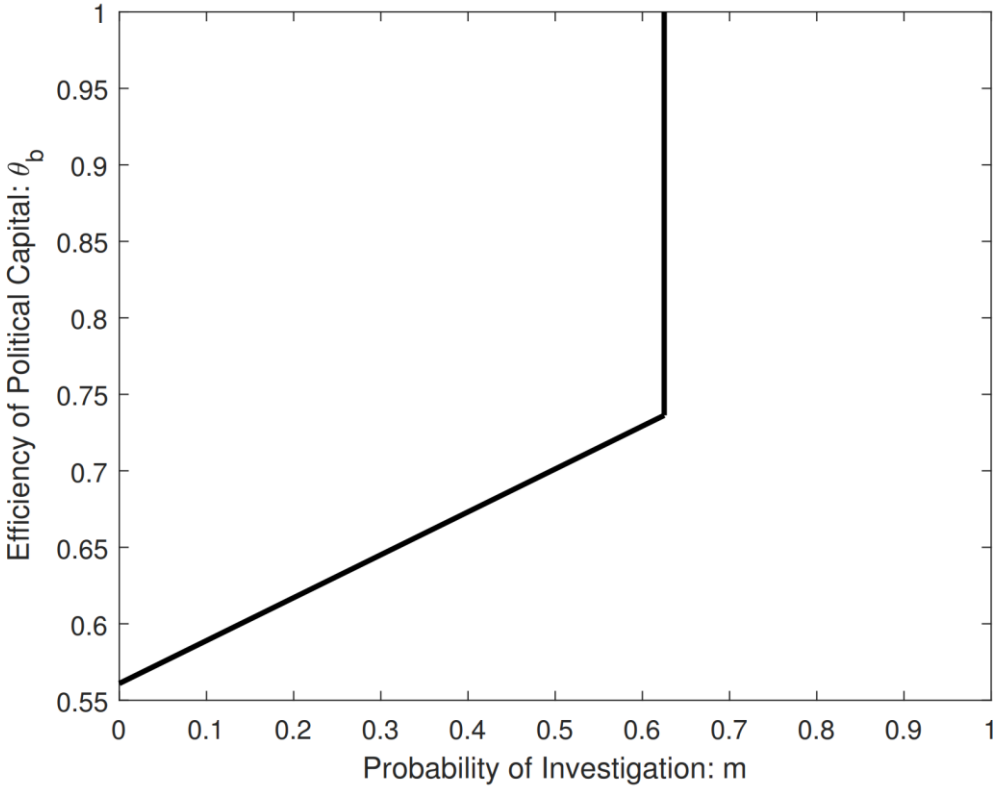


Figure 3: Feasible Set for the Bubbly Equilibrium

the value of physical capital rises due to less crowd out effect of the political capital. Compared with PC firms, the NPC firms can make use of their capital to borrow more money and face a loose credit constraint. In this case, the physical capital and investment flows from the PC sector to the NPC sector as figure 4 shows. Considering the concavity of the first four figures and the convexity of other figures in figure 4, we also find that if the level of corruption is large enough, the government needs to conduct strong campaigns to achieve a significant outcome.

## 5.2 Dynamics

We now investigate the dynamic results of a anti-corruption shock ($\theta_b$ decreases) on the political capital market and the real economy. From figure 5, the price of bubbly asset decreases immediately after the announcement of the anti-corruption policy, which is consistent with our observation in the data. Figure 5 shows that PC firms avoid the inefficient overinvestment because they cannot use political capital to obtain a number of loans as before. The price of physical capital increases and then NPC firms are able to investment more with a loose credit constraint. As a result, the capital flows from the PC sector to the NPC sector. The consumption and total social welfare increase as the degree of corruption decreases.

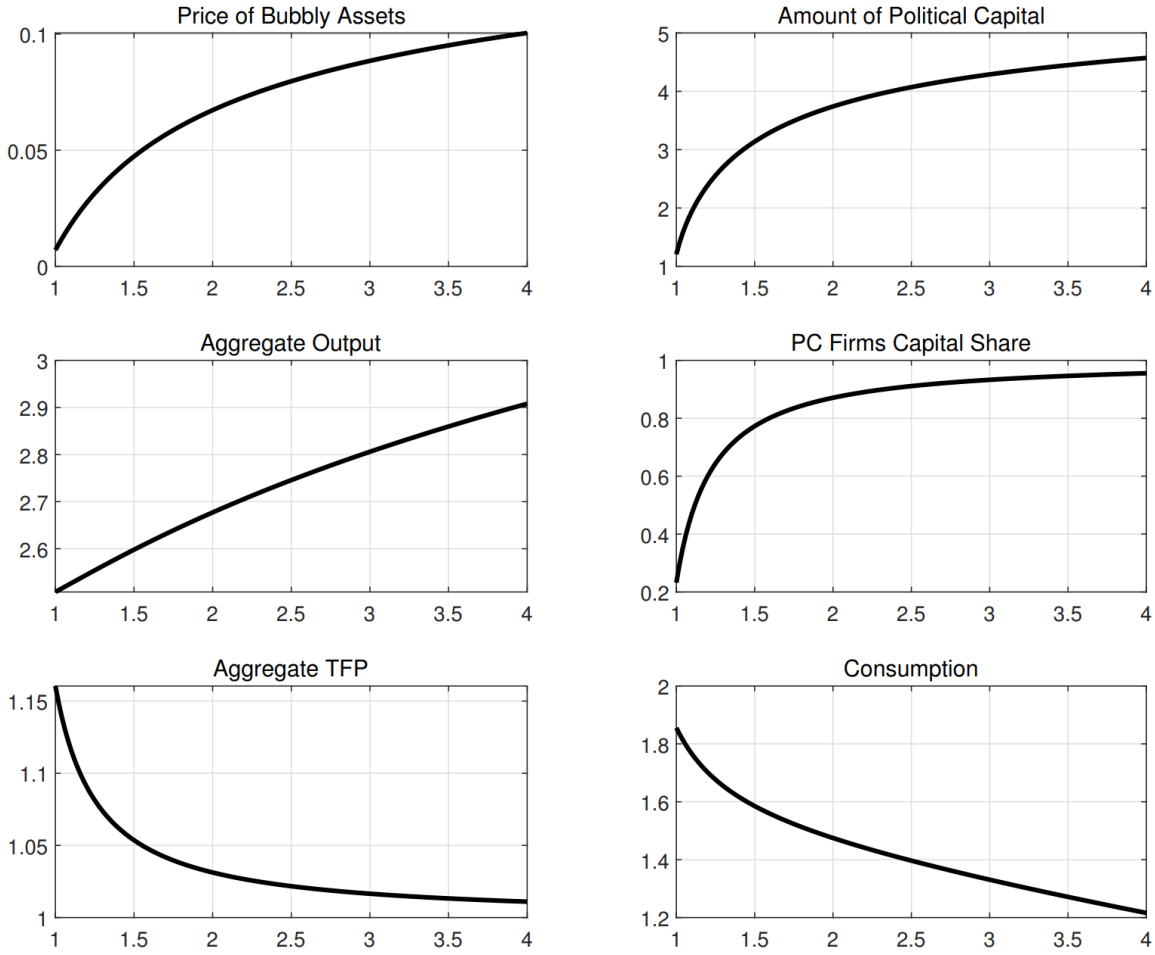


Figure 4: Bubbly Steady State under Anti-corruption Policy: $\theta_b$

The strength of campaigns is important. We compare the transition dynamics under anti-corruption policies of different degrees (different $\theta_b$) in figure 6. We set the initial steady state at $\theta_b$ = 1:5. The black line corresponds to the final steady state at $\theta_b$ = 1.1, the purple one to $\theta_b$ = 1, and the blue one to $\theta_b$ = 1.2.

The economy experiences a dramatic change under a larger shock--the bubble bursts more quickly, capital flows from PC to NPC more rapidly, and consumption rise up in a more significant way. Additionally, the dynamic marginal effect of campaigns is increasing as the level of anti-corruption rises, which is consistent with results of steady state shown in figure 4. The implication of the pattern is that once determined to stop the corruption, the government needs to take powerful actions instead of moderate operations, like Chinese sayings "be braced for the pain" (刮骨疗毒) which is often mentioned by president Xi Jinping.

We take quantitative exercise to test the sensitivity of parameters. The parameter $\zeta$ measures the marginal cost of corruption for PC firms, and $\chi$ for government officials. Due to lack of the real data, we cannot calibrate their values accurately. However, they should be less than one the punishment is less than bribery value because of the difficulty to determine the market value of bribery goods. We keep other setting same as figure 5, and choose the corresponding parameter ($\zeta$

in figure 7, $\chi$ in figure 8) value to be [0:2 0:4 0:6 0:8 1]. It is worth mentioning $\chi$ only influences the price and amount of political capital. Then we find that anti-corruption campaigns are more effective under larger punishment of bribery and various parameters lead to a similar pattern.

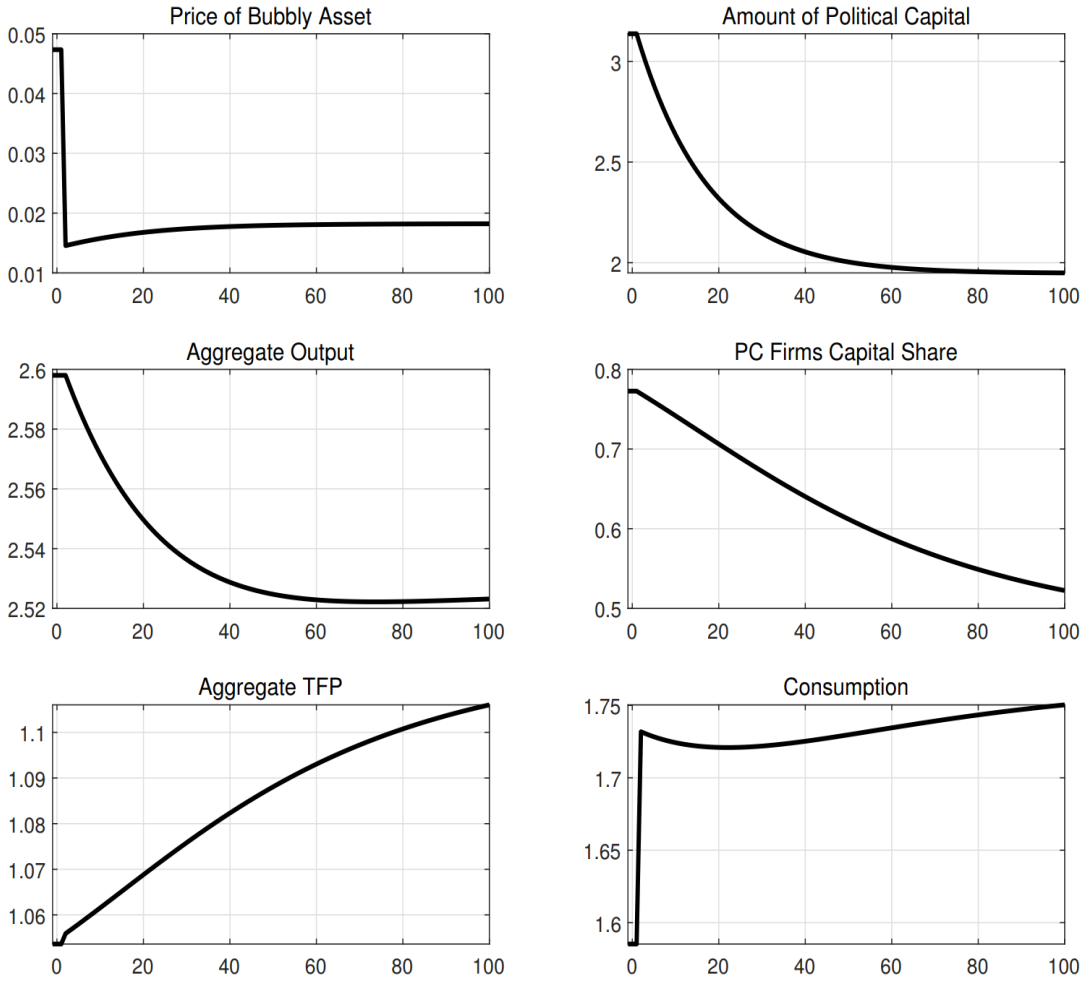


Figure 5: Transition Dynamics under Anti-corruption Policy

**Notes**: We assume that in the initial period, the economy stays at the steady state. In the first period, the effectiveness of corruption $\theta_b$ permanently decreases from 1.5 to 1.1.

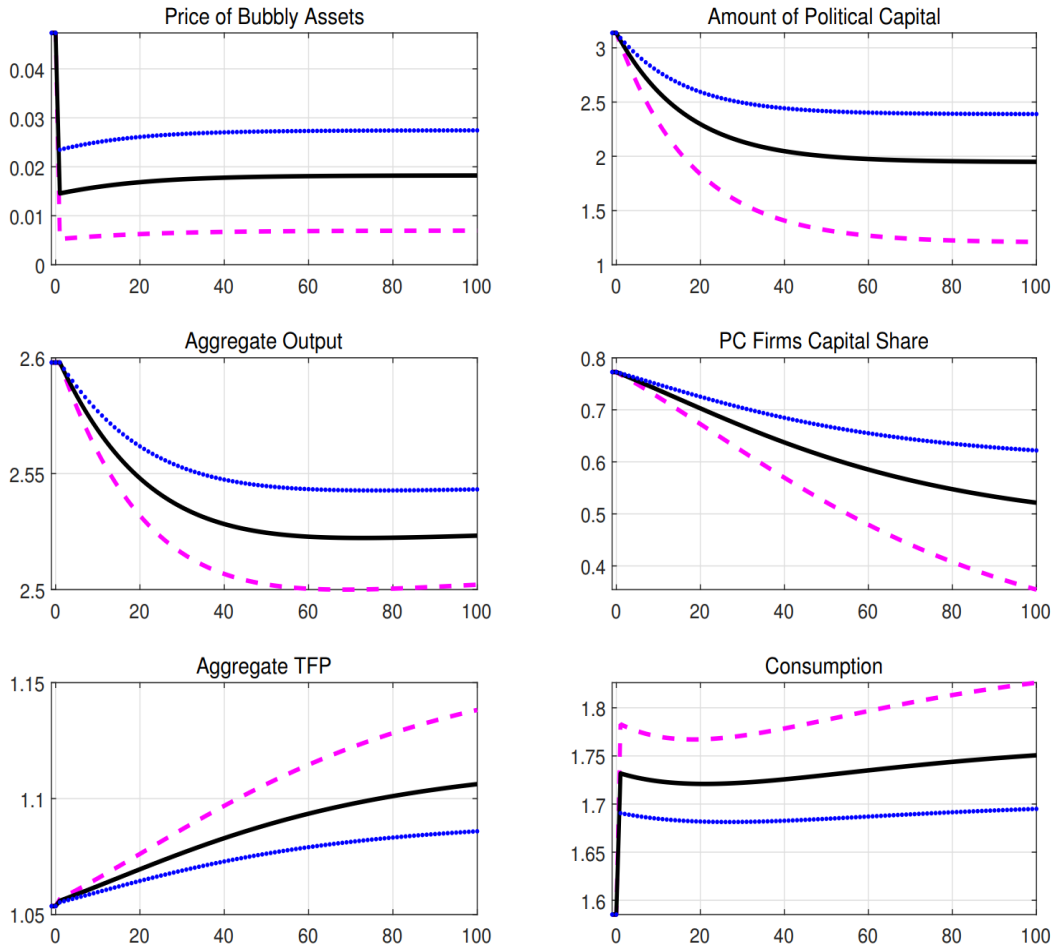


Figure 6: Transition Dynamics under Anti-corruption Policies of Different Degrees

**Notes**: We compare the transition dynamics under anti-corruption policies of different degrees. We set the initial steady state at $\theta_b = 1.5$. The black line corresponds to the final steady state at $\theta_b = 1.1$, the purple one to $\theta_b = 1$, and the blue one to $\theta_b = 1.2$.

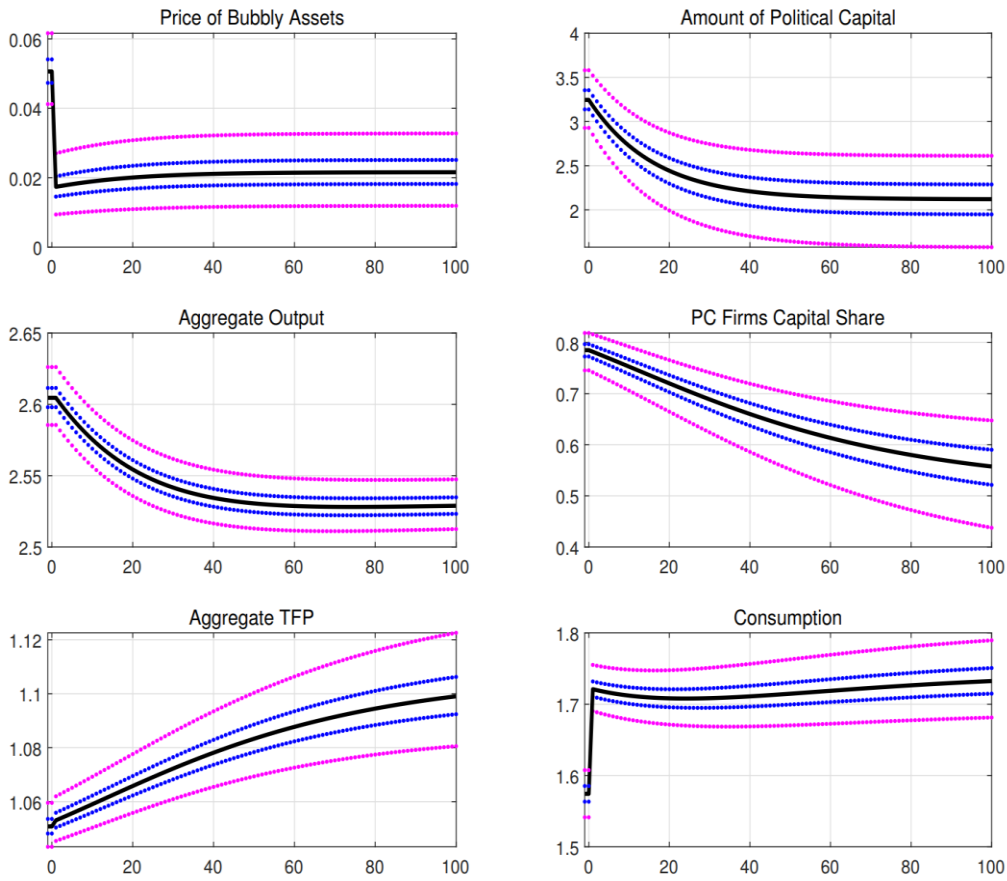


Figure 7: Sensitivity Analysis of Parameters: $\zeta$

**Notes**: We take sentivity analysis of $\zeta$, marginal cost of corruption for PC firms. We set the value of $\zeta$ to be 0.2 , 0.4, 0.6, 0.8, and 1, and get a band of the five results.

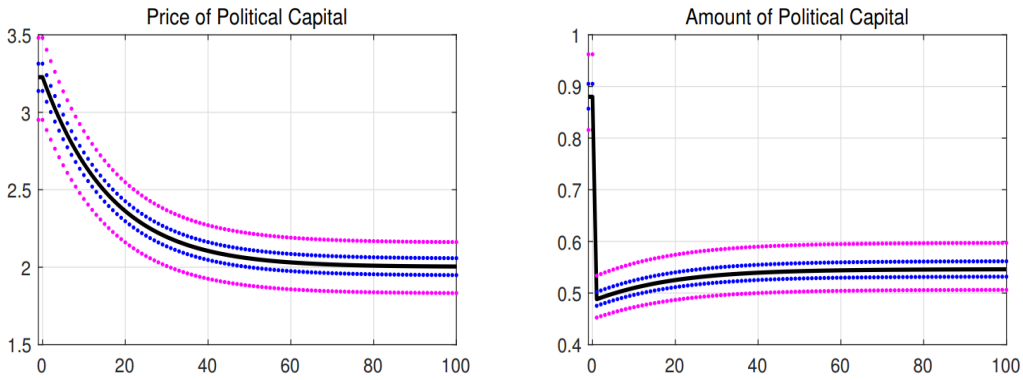


Figure 8: Sensitivity Analysis of Parameters: $\chi$

**Notes**: Similar to figure 7, we take sentivity analysis of $\chi$, marginal cost of corruption for government officials. We set the value of $\chi$ to be 0.2 , 0.4, 0.6, 0.8, and 1, and get a band of the five results. We only report the results of the price and amount of political capital because other variables are not affected by $\chi$.

# 6. Conclusion

China's artwork markets show large volatility and the price dynamics are significantly sensitive to the degree of corruption. Observing these facts, we use exogenous anti-corruption campaigns to test the positive relationship between the bubble and corruption. Then we propose a theory to explain what causes the bubble, and its role in the aggregate economy. Then we use our model to analyze a list of anti-corruption actions quantitatively in China. We find that when corruption is impeded, the bubble devalues with decreasing liquidity premium and the value of physical capital increases. As a result, the investment and capital flow from the PC sector to the NPC sector. In a sum, the anti-corruption policy alleviates the crowd effect of the political capital, decreases the inefficient overinvestment of PC firms, and increases the consumption, which raises the social welfare.

# References

[1] **Aoki, Kosuke and Kalin Nikolov**, "Bubbles, Banks and Financial Stability," *Journal of Monetary Economics*, 2015, *74*, 33-51.

[2] **Cai, Hongbin, J Vernon Henderson, and Qinghua Zhang**, "China's Land Market Auctions: Evidence of Corruption?," *The RAND Journal of Economics*, 2013, *44* (3), 488-521.

[3] **Chen, Kaiji and Yi Wen**, "The great housing boom of China," *American Economic Journal: Macroeconomics*, 2014, *9* (2), 73-114.

[4] **Claessens, Stijn, Erik Feijen, and Luc Laeven**, "Political connections and preferential access to finance: The role of campaign contributions," *Journal of Financial Economics*, 2008, *88* (3), 554-580.

[5] **Ding, Haoyuan, Hanming Fang, Shu Lin, and Kang Shi**, "Equilibrium consequences of corruption on firms: Evidence from China's anti-corruption campaign," Technical Report, Working Paper. University of Pennsylvania 2017.

[6] **Dong, Feng, Zhiwei Xu, and Yu Zhang**, "Bubbly Bitcoin," *Ssrn Electronic Journal*, 2018.

[7] **Du, Jun and Sourafel Girma**, "Red capitalists: political connections and firm performance in China," *Kyklos*, 2010, *63* (4).

[8] **Farhi, E. and J. Tirole**, "Bubbly Liquidity," *Review of Economic Studies*, 2012, *79* (2), 678-706.

[9] **Giannetti, Mariassunta, Guanmin Liao, Jiaxing You, and Xiaoyun Yu**, "The externalities of corruption: Evidence from entrepreneurial activity in China," 2017.

[10] **Hao, Zhuoqun, Yu Liu, Jinfan Zhang, and Xiaoxue Zhao**, "Political connection, corporate philanthropy and efficiency: Evidence from China's anti-corruption campaign," *Journal of Comparative Economics*, 2020.

[11] **Jermann, Urban and Vincenzo Quadrini**, "Macroeconomic effects of financial shocks," *American Economic Review*, 2012, *102* (1), 238-71.

[12] **Kiyotaki, Nobuhiro and John Moore**, "Credit cycles," *Journal of political economy*, 1997, *105* (2), 211-248.

[13] **Lan, Xiaohuan and Wei Li**, "Swiss Watch Cycles: Evidence of Corruption during Leadership Transition in China," *Journal of Comparative Economics*, 2018, *46* (4), 1234-1252.

[14] **Li, Bo, Zhengwei Wang, and Hao Zhou**, "China's anti-corruption campaign and credit reallocation from SOEs to non-SOEs," *PBCSF-NIFR Research Paper*, 2018, (17-01).

[15] **Li, Hongbin, Lingsheng Meng, Wang Qian, and Li An Zhou**, "Political connections, financing and firm performance: Evidence from Chinese private firms," *Journal of Development Economics*, 2008, *87* (2), 0-299.

[16] **Lin, Chen, Randall Morck, Bernard Yeung, and Xiaofeng Zhao**, "Anti-corruption reforms and shareholder valuations: Event study evidence from China," Technical Report, National Bureau of Economic Research 2016.

[17] **Martin, Alberto and Jaume Ventura**, "Economic Growth with Bubbles," *American Economic Review*, 2012, *102* (6), 3033-3058.

[18] _ **and** _, "The Macroeconomics of Rational Bubbles: A User's Guide," *Annual Review of Economics*, 2018, *10* (1), 505-539.

[19] **Miao, Jianjun**, "Introduction to economic theory of bubbles," *Journal of Mathematical Economics*, 2014, *53*, 130-136.

[20] _ **and Pengfei Wang**, "Asset bubbles and credit constraints," *American Economic Review*, 2018, *108* (9), 2590-2628.

[21] _, _, **and Zhiwei Xu**, "A Bayesian dynamic stochastic general equilibrium model of stock market bubbles and business cycles," *Quantitative Economics*, 2015, *6* (3), 599-635.

[22] _, _, **and Zhou Jing**, "Asset Bubbles, Collateral, and Policy Analysis," *Journal of Monetary Economics*, 2015, *76* (1805), S57-S70.

[23] **Qian, Nancy and Jaya Wen**, "The impact of Xi Jinping's anti-corruption campaign on luxury imports in China," *Preliminary Draft, Yale University*, 2015.

[24] **Santos, Manuel S and Michael Woodford**, "Rational Asset Pricing Bubbles," *Econometrica*, 1997, *65* (1), 19-57.

[25] **Tirole, Jean**, "Asset Bubbles and Overlapping Generations," *Econometrica*, 1985, *53* (6), 1497.

[26] **Wang, Pengfei and Yi Wen**, "Speculative bubbles and financial crises," *American Economic Journal: Macroeconomics*, 2012, *4* (3), 184-221.

[27] **Xu, Gang and Go Yano**, \How does anti-corruption affect corporate innovation? Evidence from recent anti-corruption efforts in China," *Journal of Comparative Economics*, 2017, *45* (3), 498-519.

# Appendix

## A Proof of Propositions

**Proof of Proposition 1:**

We use guess-and-verify strategy to solve the optimal problem. We conjecture that the value function $V_{jt}^s(k_{jt}^s, l_{jt}^s, \varepsilon_{jt})$ of PC firms, takes the form of

$$V_{jt}^s(k_{jt}^s, l_{jt}^s, \varepsilon_{jt}) = v_{kt}(\varepsilon_{jt})k_{jt}^s + v_{bt}(\varepsilon_{jt})b_{jt} - v_{lt}(\varepsilon_{jt})l_{jt}^s \quad (A.1)$$

The firm's dynamic programming problem can be written as

$$\begin{aligned} &v_{kt}(\varepsilon_{jt})k_{jt}^s + v_{bt}(\varepsilon_{jt})b_{jt} - v_{lt}(\varepsilon_{jt})l_{jt}^s \\ &\quad = \max R_t^s k_{jt}^s - l_{jt}^s + (v_{kt+1}\varepsilon_{jt} - 1)i_{jt}^s + \left[v_{bt+1} - \left(\frac{1+m_t\zeta}{\xi}\right)P_t\right]b_{jt+1} \\ &\quad - \left(v_{lt+1} - \frac{1}{R_{ft}}\right)l_{jt+1}^s + v_{kt+1}(1-\delta)k_{jt}^s + \left(\frac{1+m_t\zeta}{\xi}\right)P_t(1-\delta_b)b_{jt} \quad (A.2) \end{aligned}$$

where

$$v_{mt+1} = \beta \int_{\varepsilon_{min}}^{\varepsilon_{max}} v_{mt+1}(\varepsilon_{jt+1})\, d\boldsymbol{F}(\varepsilon_{jt+1}), m \in \{k, b, l\} \quad (A.3)$$

subject to (24) and

$$0 \le i_{jt}^s \le R_t^s k_{jt}^s + \frac{1}{R_{ft}}l_{jt+1}^s - l_{jt}^s \le R_t^s k_{jt}^s + \theta_k(1-\delta)Q_t^s k_{jt}^s + \theta_b(1-\delta_b)P_t b_{jt} - l_{jt}^s \quad (A.4)$$

where the second inequality is from (4)(8)(10) and the last inequality follows from debt financing constraint (9). Since the objective function is linear in $i_{jt}^s$, the optimal decision for investment follows a trigger strategy. That is, there exists a critical value $\varepsilon_{st}^* = 1/v_{kt+1}$ that if $\varepsilon_{jt} < \varepsilon_{st}^*$, the firm would not invest, i.e., $i_{jt}^s = 0$. If $\varepsilon_{jt} \ge \varepsilon_{st}^*$, the firm would choose $i_{jt}^s = R_t^s k_{jt}^s + \frac{1}{R_{ft}}l_{jt+1}^s - l_{jt}^s$. Substituting the optimal investment rule into the Bellman equation, we derive

If $\varepsilon_{jt} < \varepsilon_{st}^*$, no arbitrage conditions for $b_{jt+1}$ and $l_{jt+1}^s$ are

$$v_{lt+1} = \frac{1}{R_{ft}} \quad (A.5)$$

$$v_{bt+1} = \left(\frac{1+m_t\zeta}{\xi}\right)P_t \quad (A.6)$$

By matching coefficients, we know

$$v_{kt}(\varepsilon_{jt}) = (1-\delta)Q_t^s + R_t^s \qquad (A.7)$$

$$v_{bt}(\varepsilon_{jt}) = \left(\frac{1+m_t\zeta}{\xi}\right)P_t(1-\delta_b) \qquad (A.8)$$

where we define $Q_t^s = v_{kt+1}$.

If $\varepsilon_{jt} \geq \varepsilon_{st}^*$ , the debt financing constraint (9) is binding such that

$$i_{jt}^s = R_t^s k_{jt}^s + \theta_k(1-\delta)Q_t^s k_{jt}^s + \theta_b(1-\delta_b)P_t b_{jt} - l_{jt}^s \qquad (A.9)$$

$$v_{kt}(\varepsilon_{jt}) = R_t^s \frac{\varepsilon_{jt}}{\varepsilon_{st}^*} + (1-\delta)Q_t^s\left[1+\theta_k\left(\frac{\varepsilon_{jt}}{\varepsilon_{st}^*}-1\right)\right] \qquad (A.10)$$

$$v_{bt}(\varepsilon_{jt}) = P_t(1-\delta_b)\left[\left(\frac{1+m_t\zeta}{\xi}\right)+\theta_b\left(\frac{\varepsilon_{jt}}{\varepsilon_{st}^*}-1\right)\right] \qquad (A.11)$$

Taking the expectation on both sides of equation (A.7)(A.10), we can derive the Euler equation for physical capital(26). From (A.6)(A.8)(A.11), substituting the expression for $v_{bt}$ and taking the expectation, we conclude that (27) is Euler equation for the price of political capital

**Proof of Proposition 2:**
Using the same guess-verify-strategy as proposition 1, we get a mirrored proof of proposition 2.

# B Eight-Point Policy

• Leaders must keep in close contact with the grassroots. They must understand the real situation facing society through in-depth inspections at grassroots. Greater attention should be focused on places where social problems are more acute, and inspection tours must be carried out more thoroughly. Inspection tours as a mere formality should be strictly prohibited. Leaders should work and listen to the public and officials at the grassroots, and people's practical problems must be tackled. There should be no welcome banner, no red carpet, no floral arrangement or grand receptions for officials' visits.

• Meetings and major events should be strictly regulated, and efficiency improved. Political Bureau members are not allowed to attend ribbon-cutting or cornerstone-laying ceremonies, or celebrations and seminars, unless they get approval from the CPC Central Committee. Official meetings should get shortened and be specific and to the point, with no empty and rigmarole talks.

• The issuing of official documents should be reduced.

• Officials' visits abroad should only be arranged when needed in terms of foreign affairs with fewer accompanying members, and on most of the occasions, there is no need for a reception by overseas Chinese people, institutions and students at the airport.

• There should be fewer traffic controls when leaders travel by cars to avoid unnecessary inconvenience to the public. There should be fewer traffic controls arranged for the leaders' security of their trips to avoid unnecessary inconvenience to the public.

• The media must not report on stories about official events unless there is real news value. The regulations also ban worthless news reports on senior officials' work and activities and said such reports should depend on work needs, news value and social effects.

• Leaders should not publish any works by themselves or issue any congratulatory letters unless an arrangement with the central leadership has been made. Official documents without substantial contents and realistic importance should be withheld. Publications regarding senior officials' work and activities are also restricted.

• Leaders must practice thrift and strictly follow relevant regulations on accommodation and cars.

# Acknowledgements

First of all, I want to thank my mentor, who is my academic leader. His rigorous scholarship, clear teaching, and warm help for students are my role models for lifelong learning. In addition, I would also like to thank my mentor and professor Dong for their joint guidance. It is their continuous help and recommendation in thesis and application that have allowed me to make continuous progress. In addition, I would like to thank professor Qian for his helpful comments on this article, the recommendations during the application, and the answers on academic issues in the past four years. I also thank professor Zhu for his helpful comments on this paper.

I also want to thank my parents for their support, the professors at Jiao Tong University for their help, and the unforgettable and happy time brought by my three roommates and many friends.

The sun rises and sunsets, and time flies. I have spent four full and enjoyable years in Antai, Jiao Tong University, and it is time to embark on a new journey.