Institutions, Political Cycles and Corruption

Essays on Dynamic Political Economy of Government

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Abstract

This thesis consists of three self-contained essays.

The first essay, "China Political Business Circle", uncovers the evidence of political business cycles in China's key macro variables after the economic reform starting in 1977. It also provides a theory to explain the mechanism of the political business cycle, incorporating the fundamental institutional features after the reform: economic decentralization, political centralization and central government intervention when necessary. An empirical test of the theory, using a panel of provincial level data, derives a result consistent with the predictions of the theory. The essay also clearly defines the China Model of Growth.

The second essay, "A Theory of Dynastic Cycle", proposes a dynamic politico-economic theory on the dynastic cycle, a repeating pattern throughout China's history. While each new dynasty is initially strong under the ruling of a new royal family, it degenerates over time until being replaced by another royal family after civil wars, peasants' rebellions or foreign invasions. The core of the theory is the crown prince problem faced by an incumbent ruler. Choosing a politically stronger successor is economically beneficial since the successor will be able to control the bureaucrats well and prevent bureaucratic corruption from being high in the future. This encourages the current investment made by forward-looking citizens and thus increases the tax base of the incumbent ruler. On the other hand, a politically stronger successor has a higher probability of replacing the incumbent ruler and seizing the power earlier. The theory predicts that, consistent with historical evidence, when all rulers are primarily concerned with their own safety, the quality of the successors (future rulers) will become increasingly worse, and

bureaucratic corruption will increase over time. High corruption has two effects on the economy. On the one hand, it increases the burden of the citizens and increases the possibility of rebellions. On the other hand, it reduces the tax base of the ruler and makes the dynasty vulnerable to negative shocks and rebellions. The combination of both effects increases the probability of the collapse of the dynasty.

The third essay, "A Politico-Economic Theory of Corruption in Non-Democracy", is based on three building blocks. First, a non-democratic ruler needs to delegate the power to some agents. Second, a more patient ruler cares more about the future and sets less extractive policies. Third, the agent has the chance to replace the ruler and to be corrupt, both due to the weak institutions. Adding up the three blocks, this essay shows that the ruler has a demand for corrupt agents. The reason is as follows. A corrupt agent cares more about the corrupt income in the short run and loses the chance to be the ruler in the long run as such an impatient agent is unlikely to get the support to replace the ruler due to the potential extractive policy he is likely to set as a ruler. But this makes the corrupt agent attractive to the ruler, as they are politically reliable.

To my family

Acknowledgments

Analyzing economic problems is like watching a stage drama, in that with the opening of every curtain, the slot is becoming clear by and by. But unlike the stage drama, for many economic problems, the common thing behind the last curtain is politics, without the understanding of which, it is even impossible to see what is behind the several curtains before the last. As a political economist, I am lucky that I met the right professors, who raised me up from being in the audience to being a director or a writer who can at least stand behind the last curtains of some dramas.

First and foremost, I would like to thank my advisor John Hassler for his excellent, patient and tough guidance, for his sincere encouragement, for his wise and kind understandings when various problems arise and for his generosity in sparing some space on his shoulder where I can stand.

I am deeply indebted to my co-advisor, Per Krusell and to Torsten Persson, who acts implicitly as my co-advisor, especially for their input into my job market paper. Interestingly, my impressions of the two professors are apparently complete opposites. Per is like a benevolent bandit because if he wants to kill a paper, it is impossible to survive; while if he wants to save a paper, it must survive and live strong. Fortunately, only the latter happened to me. Torsten is like an experienced judge as he always knows the things behind the last curtain of most dramas in advance. But he needs to motive me to find the paths with the right steps to the end point. This process is hard, but worthy and smooth due to Torsten.

I am also grateful to Yves Zenou, who is also my co-advisor, and to David Strömberg, who also implicitly acts as my co-advisor. Yves can always capture the key points when things are unclear in an unbelievably fast way and give the intelligent answers to my questions succinctly. This makes it possible for us to talk about many other things inside and outside research during our communications, from which I learn a lot. David is not as hurried as Yves in talking about research. He analyzes my research questions patiently,

plumbing them deep, and shares his insights without any reservations. Such discussions always end up with something constructive and more importantly, new interesting research questions. I also need to apologize to David for torturing him with so many stupid econometrics questions.

Special thanks go downstairs to the Economics Department where I spent my early years as a Ph.D student. I appreciate the communication with Hans Wijkander, his encouragement, his humor, his effort in revising my paper word by word, and his insights and experience from China, in particular the price of the Chinese bride. I very much miss the interaction with Jonas Agell, who was my mentor. I believe that Jonas unfortunately lost his smart phone and because of this, I cannot get in touch with him now. My heart is with Jonas.

I have enjoyed the communications with several other professors, for instance, Assar Lindbeck and Mats Persson. Assar has shared a great deal of his knowledge of socialist economic systems and their transitions with me. I especially want to thank Assar for telling me about the mechanism of inflation in the socialist systems, which still applies to current China and turns out to be the key in my job market paper. I got to know Mats pretty late and we often discuss issues in politics, culture, history and economics. During our talks, I feel that we have known each other in several rounds of reincarnations and we were at least producing porcelain together in the Chinese Song Dynasty (960-1279). From the discussions with Mats, I know that examining the causes and consequences of historical events and judging the value of antiques are like watching a stage drama, in that with the opening of every curtain ... politics ... shoulder ... bandit ... judge ... so on and so forth ...

Yinan Li
2012.12.9 in Stockholm

Table of Contents

Chapter 1

Introduction

1.1 Introduction

This thesis consists of three self-contained essays, with a focus on the interaction of institutions, political cycles and corruption. Chapter 2 studies the institutional determinant of the business cycle in contemporary China. Chapter 3 goes back to ancient China and studies the mechanism of the dynastic cycle, in which institutions and corruption play the major roles. Chapter 4 studies the institutional determinant of corruption in non-democracy, motivated by China's historical case studies.

In all three essays, the institutional setting is non-democratic. Methodologically, by borrowing the insight from politico-economic studies in democracy that analyze how elections shape the politicians' incentive (summarized in Persson and Tabellini 2000), I plumb how the change of power affects the politicians' incentive in non-democracy. In Chapter 2, the focus is how the change of power at the mid-level distorts the incentive of the career concern motivated politicians at the same level and how the distortion translates to business cycles, the timing of which correlates with the timing of power change. In Chapter 3 and 4, the focus is how the change of power at the top level, due to the coup by the ruler's successor or the ruler's agent, shapes the

ruler's incentive to choose successors and agents, respectively. The method in the latter two chapters can be summarized as "coup is equivalent to election".

Technically, the equilibia in the three essays all have a Markovian feature. In a private talk with Lars Ljungqvist some years ago, Lars did not like the Markov Equilibrium very much, as the theme in many macroeconomic issues, monetary policies for instance, is the reputation. I think this also represents the view of many other economists. My reply to Lars was that at least in the field of political economy, it is realistic to assume the forward-looking politicians rationally forget the past, make decisions based on the current state to maximize future values. Lars agreed with me and he decided to add a chapter on Markov Equilibrium in the new version of his influential textbook, "Recursive Macroeconomic Theory", which is coauthored with Thomas Sargent. My reply to Lars applies to any questions regarding the Markov Equilibrium in my thesis.

Chapter 2, **"China Political Business Circle",** uncovers the fact that China's business cycle corresponds to the timing of the Communist Party's Congress. The pattern of the cycle is that investment growth increases sharply after each Congress and falls dramatically before the next one. The fundamental cause of China's political business cycle is China's institutions. From the start of the economic reform in the late 1970s', the central government delegates the economic decision power to the local leaders and the promotion of local leaders, determined at the Party Congress, which is held once every five years, is retrospectively based on the local leaders' economic performance. Upon getting power at the Party Congress, the local leaders have a strong incentive to stimulate growth within the regions they lead. The hunger for growth has inflationary consequences as it is constrained by the supply capacity of the economy. When inflation increases, the central government intervenes with contractionary policies, which involve centralizing the authority of investment approval and credit allocation, and stopping ongoing investment projects. With the decrease of inflation, the economic authori-

ties are once more delegated to the local leaders. The stop-go feature of the economy is thus repeated over time. A carer concern model is constructed and a test of the model using a panel of provincial level data derives a result consistent with the predictions of the model.

Chapter 3, **"A Theory of Dynastic Cycle"**, proposes a dynamic politico-economic theory on the dynastic cycle, a repeating pattern throughout China's history. While each new dynasty is initially strong under the ruling of a new royal family, it degenerates over time until being replaced by another royal family after civil wars, peasants' rebellions or foreign invasions. At the heart of the theory is the crown prince problem faced by each incumbent ruler. On the one hand, choosing a politically stronger successor is economically beneficial since the successor will be able to control the bureaucrats well and prevent bureaucratic corruption from being high. This encourages the current investment made by forward-looking citizens and thus increases the tax base of the incumbent ruler. On the other hand, a politically stronger successor has a higher probability of replacing the incumbent ruler and seizing the power earlier. The incumbent ruler's trade-off between tax base and safety is embedded into an OLG model and the analytical solution to the Markov Perfect Political Equilibrium is derived. The theory predicts that, consistent with historical evidence, when all rulers are primarily concerned with their own safety, the quality of the successors (future rulers) will become increasingly worse, and bureaucratic corruption will increase over time. High corruption has two effects on the economy. On the one hand, it increases the burden of the citizens and endogenously increases the possibility of rebellions. On the other hand, it reduces the tax base of the ruler. A fiscally feeble dynasty is vulnerable to rebellions, invasions and any negative economic shocks.

Do rulers have a demand for bureaucratic corruption in non-democracy? To answer this question, the third essay, **"A Politico-Economic Theory of Corruption in Non-Democracy"**, develops a dynamic model with three

players: a ruler, a delegate and a group of citizens. The ruler gets the tax revenue from the citizens collected by the delegate, who may replace the ruler with the support of the citizens. The tax rate is determined by the discount factor of the ruler. A more patient ruler cares more about the future and sets a lower tax rate. The delegate, who has the chance of being corrupt due to the weakness of institutions, faces a trade-off between being corrupt in the short run and becoming the ruler in the long run. Specifically, a more patient delegate can signal his higher discount factor to the citizens by being non-corrupt in the short run, which leads to a chance of becoming the ruler with the support of the citizens in the future. There exist multiple equilibria, depending on the strength of the incumbent ruler. If the incumbent's strength is sufficiently high, all types of delegates choose to be corrupt if they have low discount factors. If the incumbent's strength is not sufficiently high, a delegate with a high discount factor chooses to be non-corrupt while a delegate with a low discount factor chooses to be corrupt. Therefore, with the possibility of political replacement, the ruler prefers the corrupt delegate who is politically reliable. While the popular consensus is that corruption is bad, the implication in the essay is that moderate corruption is a socially efficient mechanism for the delegate to signal his loyalty to the ruler. The effort to reduce corruption can affect the stability of non-democratic regimes and thus reduce welfare, either by impeding the transmission of the signal or by inducing the politicians to use more socially costly ways of signaling.

1.2 Reference List

Ljungqvist, Lars and Thomas Sargent (2004). *"Recursive Macroeconomic Theory"* (with Thomas J. Sargent), MIT Press, second edition.

Persson, Torsten and Guido Tabellini (2000). *"Political Economics–Explaining Economic Policy"*, MIT Press: Cambridge.

Chapter 2

China's Political Business Circle*

2.1 Introduction[1]

China has been very important for the current global economic recovery and macroeconomic events in China are likely to play an even larger role in the future. Despite this and the fact that China's institutions are different from those of a Western democracy, there is little empirical and theoretical work on the determinants of Chinese business cycles. This paper primarily aims at partly filling this gap. Moreover, by studying the mechanism of the business cycle, we clearly define the China Model of governance and growth.

*The idea for this paper originates from a talk with Roger Myerson in 2009. I would like to thank my advisor, John Hassler, for his excellent guidance and encouragement in this project. I am grateful to Per Krusell, Assar Lindbeck, Torsten Persson and David Strömgberg for insightful discussions and to Philippe Aghion, Tobias Broer, Nicola Pavoni, Kjetil Storesletten, Hans Wijkander, Yves Zenou, Fabrizio Zilibotti and seminar participants at the Econometric Society European Winter Meeting, the IIES Macro Group and IIES Brownbag for helpful comments. I also thank Louise Johannesson and Yulian Xu for research assistance and Christina Lönnblad for editorial assistance. Financial suport from Handelsbanken's Research Foundation is gratefully acknowledged. All errors are mine.

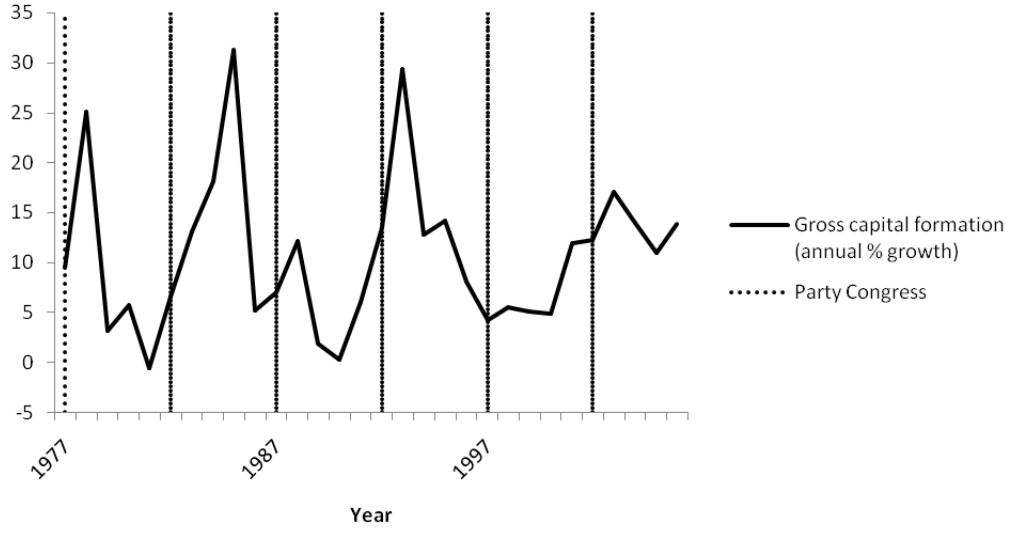
[1]Unless otherwise stated, the data in this paper comes from World Development Indicators Database at the World Bank.

We begin by presenting several facts that motivate our study and will be elaborated on the next section.

First, the replacement of political leaders became a regular feature of the political system after the death of Mao Zedong in 1976. Starting in 1977, there is a Central Communist Party Congress every five years at which the Central Committee Members are changed regularly. The Congress is held either in the late autumn or the early winter in the Congress year.

Second, the growth of gross capital formation corresponds well with the timing of the Central Party Congress. In Figure 2.1, we plot the time series of gross capital formation growth, with the dashed lines indicating the Central Party Congress Years. Since China's economic growth is very capital intensive, this is a key element in the understanding of China's business cycle.

Figure 2.1: Political Investment Cycle



The figure shows that there is strong evidence of political business cycles in China—gross capital formation growth increases dramatically *after* a Central Party Congress and drops sharply *before* the next. This pattern

is repeated except in 1997-2000 when the Chinese economy was hit by the Asian Financial Crisis.

Third, gross capital formation growth correlates well with the growth of several other variables such as net domestic credit growth, M2 growth and *especially* inflation.

The second contribution of this paper, besides finding the evidence of China's political business cycle, is to explain the driving forces behind the cycles in the growths of capital formation and the other macroeconomic variables. We argue that the fundamental cause of China's business cycle is to be found in two particular features of China's institutions:

1. Economic decentralization. During the Mao period, the Chinese economy was a central-planned economy in which the central government made all decisions. In the post-Mao reform era, the central government has decentralized the economic power and delegated it to the provincial governments[1] (Lin, Tao and Liu 2005; Huang 1996; Montinola et al. 1995; Oi 1992; Qian and Weingast 1997; Weingast 1995).

2. Political centralization. The provincial leaders, who are the Communist Party Central Committee Members, are evaluated based on their economic performance. Specifically, provincial leaders with a better economic growth performance during the term have a higher probability of being promoted to the central government in Beijing, which is associated with more privilege and better future career opportunities (Chen, Li and Zhou 2005; Li and Zhou 2005; and Maskin, Qian and Xu 2000).

The combination of economic decentralization and political centralization characterizes China's fundamental institutions after 1976 and is called a "regionally decentralized authoritarian (RDA) regime" in Xu (2011). A

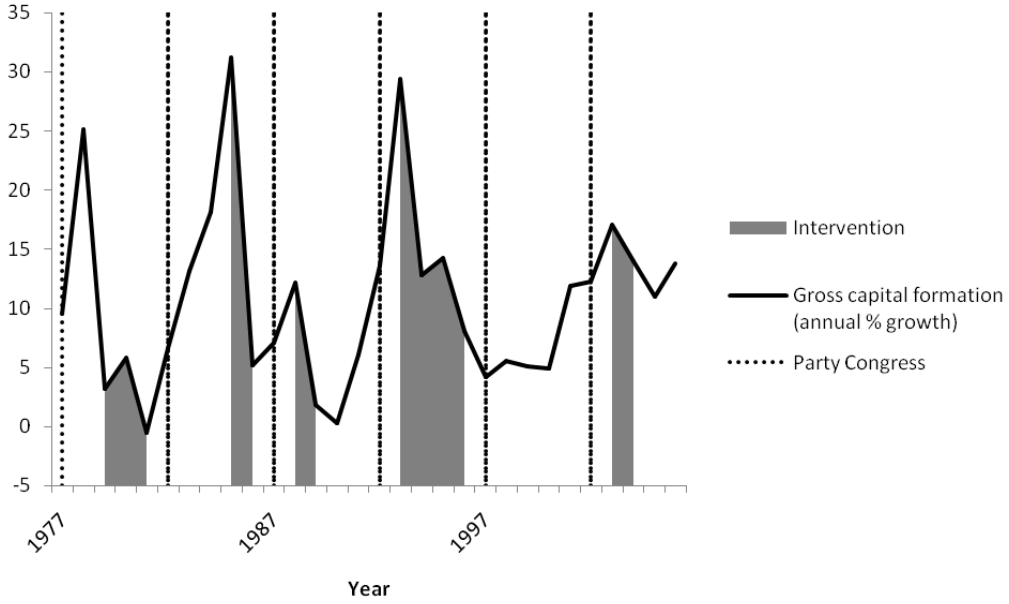
[1]There are thirty-one provinces in Mainland China. Three regions of China are outside the mainland. They are the Province of Taiwan, the Hongkong SAR and the Macau SAR.

conflict of interest between the central government and the provincial leaders, generated by the RDA regime, is key to understanding the mechanism of the political business cycle. On the one hand, the evaluation standard leads the provincial leaders, upon getting power at the Central Party Congress, to stimulate economic growth in the regions under their own governance. The provincial leaders' strong incentive to stimulate growth has inflationary consequences when it is constrained by the supply capacity of the economy (Kornai 1992). On the other hand, the central government bears the cost of inflation. When inflation becomes too high, the central government intervenes by implementing the contractionary "Macro Adjustment and Control" (Hong Guan Tiao Kong in Chinese Pinyin) program, which involves (1) re-centralizing the authority of investment approval; (2) re-centralizing the authority of credit allocation; and (3) administrative price control (Huang 1996; Lin 2008). Such intervention measures affect investment and credit on the aggregate level and all local economies are affected simultaneously. In Figure 2.2, we once more plot the time series of capital formation growth, with the shaded areas indicating the periods of intervention. During the intervention, there is a dramatic decrease in the growth rate. When inflation comes down to a tolerable level, the authorities are once more decentralized to the local leaders.

The coexistence of the relative performance based evaluation, which gives the provincial leaders a strong incentive to stimulate growth, on the one hand, and the intervention to reduce inflation due to too much growth stimulus, on the other hand, may seem contradictory. If too much aggregate stimulus increases inflation, which leads to intervention at the cost of low growth, the central government needs to consider the trade-off between the level and the variation of growth when setting the promotion rule. For example, provincial leaders with too high growth rates can be promoted with a relatively lower probability.

We propose a theory to explain the puzzle. The heart of our theory is

Figure 2.2: The Timing of Interventions



that it is time-inconsistent for the Central government to deviate from the relative performance based evaluation. Specifically, we assume that growth in each province depends on each provincial leader's competence and a hidden stimulus. The competence of each provincial leader is unknown to the central government ex ante. Ex post, the central government values the competence of the promoted leaders and extracts the information of the local leader's competence from the realized growth rate. Since promotion takes place after the realization of inflation and output growth, the central government, ex post, always has an incentive to promote provincial leaders whose regions have higher growth, as this is a signal of higher competence, no matter what is the ex ante announced promotion rule. This time inconsistency problem, plus the fact that promotion is associated with more privilege and better future career opportunities, leads to a rank-order tournament of stimulating growth among provincial leaders to signal their competence, without caring about the inflationary consequences for the whole economy. Being unable to reduce the provincial leaders' incentive ex ante, the central government can

only intervene when inflation becomes too high.

Out theory has three main predictions about the local leaders' incentive:

1. The incentive is positively related to the size of the promotion rent.
2. The incentive is negatively related to the cost of stimulus.
3. The incentive is weakest when the number of vacant positions in the central government is zero or equal to the number of provincial leaders and is strongest at some point in the middle.

We test the predictions of our theory with a panel of Chinese provincial level data from 1983 to 2007. The results are consistent with the three predictions. Regarding the first prediction, we show that the magnitude of the political cycle is decreasing in the age of the Provincial Party Secretary who is the top provincial leader. We also show the magnitude of the cycle of lame ducks, the Provincial Party Secretaries without any promotion chance due to the rule on mandatory retirement age, is significantly smaller than that of the leaders with chances for promotion. Regarding the second prediction, we show that the magnitude of the political cycle is positively related to the size of the state-owned sector, which the local leaders can control in a relatively easier way. Regarding the third prediction, we show there to be an inverted-U shaped relationship between the magnitude of the political cycle and the number of vacant positions at the Political Bureau, proxied by the number of leaders who are actually promoted at the end of each term.

Our theory shares two features of the opportunistic political business cycle literature (Nordhaus 1975; Lindbeck 1976; Rogoff and Sibert 1988; Rogoff 1990; and Persson and Tabellini 1990. See also Drazen 2000 and 2001 for surveys).[1] One is the information structure, i.e. the provincial leaders' unknown

[1]In parallel and independently, there is a partisan political business cycle literature pioneered by Hibbs (1977) and further developed by Alesina (1987). This literature focuses on the effect of the ruling party's partisan preferences on policies. See Alesina, Roubini and Cohen (1999) for a review of this strand of literature.

competence and signaling through growth. Another is the Markov feature of the equilibrium, i.e. signaling involves adverse selection and moral hazard which the forward-looking decisive voter (rationally) disregards when making the promotion decision. Our study makes two contributions to this literature. First, the empirical evidence for this literature is limited, especially from developed countries. Most supporting evidence lies in opportunistic political budget cycles in small developing countries with immature democratic institutions (Brender and Drazen 2005; Shi and Svensson 2006; Drazen 2006). Our paper contributes to this literature in that we find strong evidence of political cycles with a sizable magnitude in many key macroeconomic variables from low-frequency data in a large economy. Second and equally important, we extend this literature to a regime with strong institutions albeit different from those in a standard Western democracy.

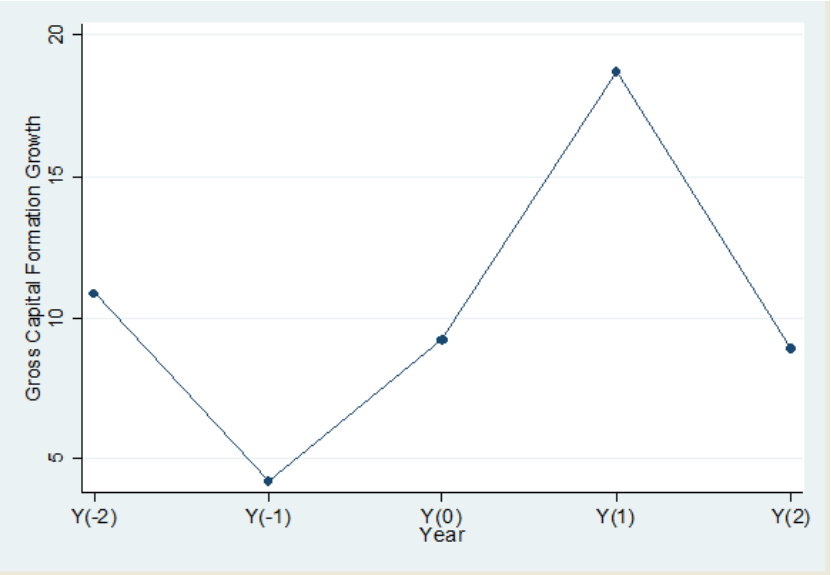
The remainder of the paper is organized as follows. The next section presents the stylized facts and Section 3 presents our model. Section 4 solves the model and Section 5 presents our empirical test. Section 6 relates our study to the existing literature. Section 7 discusses and concludes the paper.

2.2 Stylized facts

2.2.1 Political Business Cycles

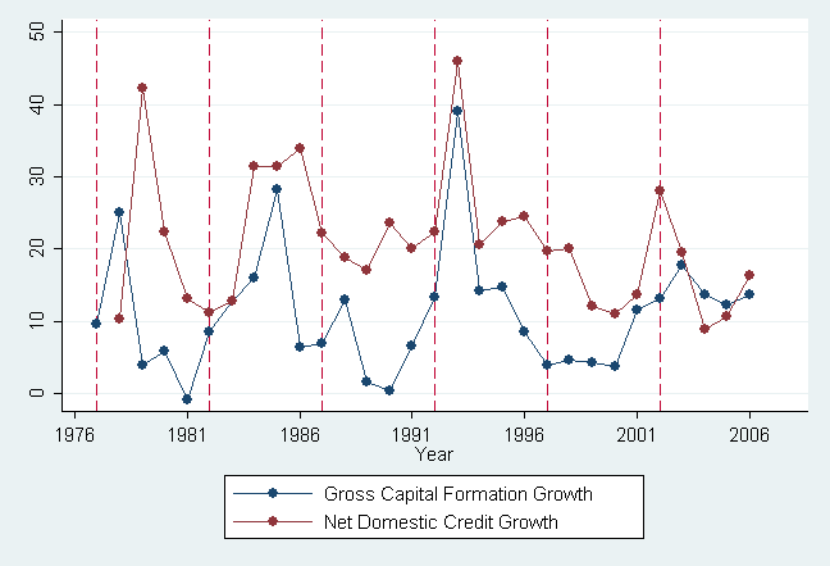
In Figure 2.3, we plot the average growth rates of gross capital formation around the Central Party Congress years, with $Y(0)$ denoting the year of the Congress, $Y(-t)$ denoting the t^{th} year before $Y(0)$ and $Y(t)$ denoting the t^{th} year after the Congress for $t = 1$ and 2. On average, gross capital formation growth starts to increase from $Y(-1)$ to $Y(0)$, further increases dramatically in $Y(1)$ and then drops sharply. This is indeed the timing in four of the five cycles. We regress gross capital formation growth on a dummy variable indicating $Y(1)$. The estimated coefficient of the dummy variable is 10.20 and it is significant at 1%.

Figure 2.3: Average Capital Formation Growth around the Party Congress



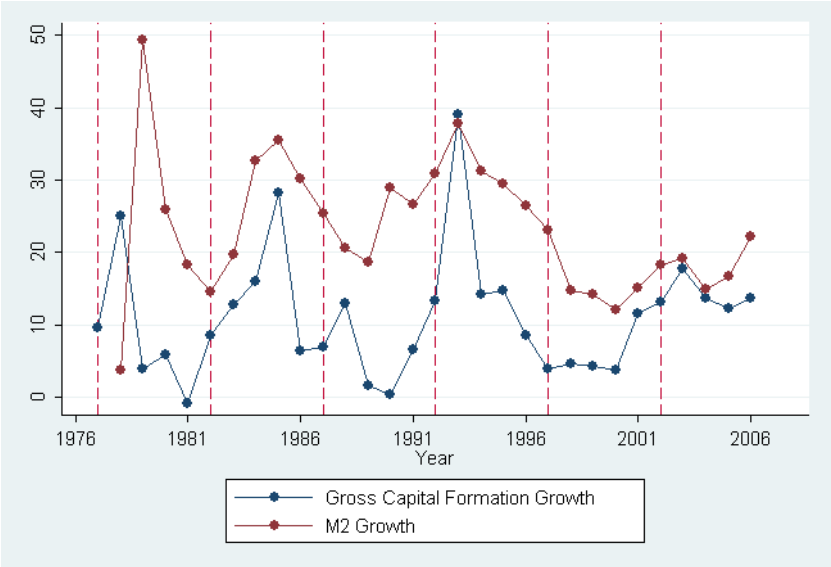
Besides the political investment cycle, there also exists a political monetary cycle. In Figures 2.4 and 2.5, we plot the time series of gross capital

Figure 2.4: Capital Formation Growth and Net Domestic Growth



formation growth with net domestic credit growth and M2 growth, respectively. We can clearly see that gross capital formation growth correlates well with the two monetary variables.

Figure 2.5: Gross Capital Formation Growth and M2 Growth



2.2.2 Institutional Background

Before the death of Mao in 1976, the Chinese economy was a central-planned economy. After that, most economic powers, such as investment approval, entry regulation, allocation of resources and fiscal revenues, management of State Owned Enterprises, and foreign trade are delegated to the provincial governments. Lin, Tao and Liu (2005) and Huang (1996) provide a detailed description of the decentralization of power. Montinola et al. (1995), Oi (1992), Qian and Weingast (1997) and Weingast (1995) focus on the decentralization of fiscal aspects.

Although the economic power is decentralized, the role of the central government remains dominant, as it determines the appointment and the promotion of provincial leaders.

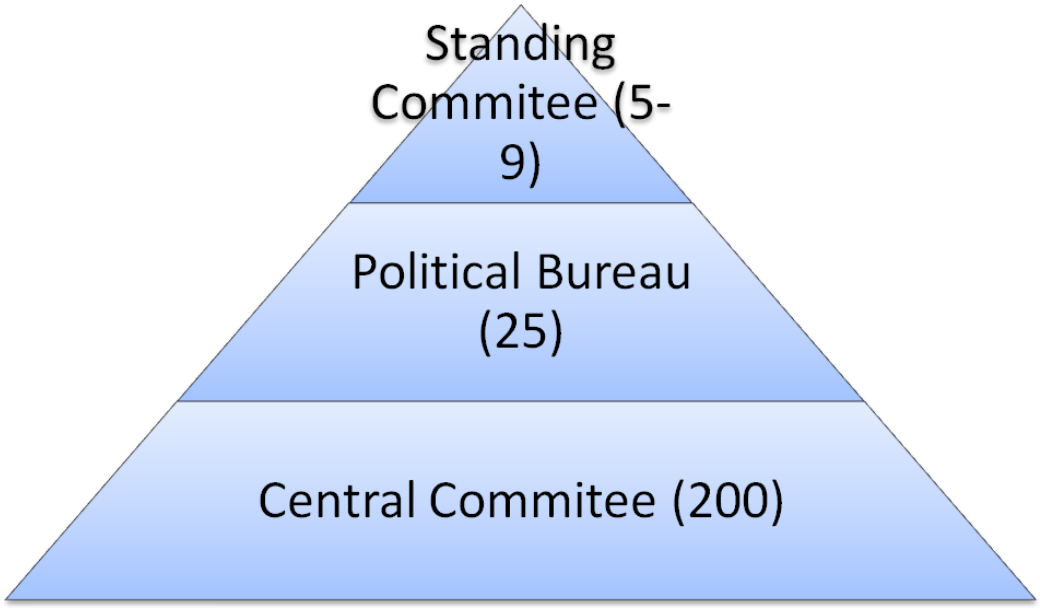
The hierarchy of the Party at the central level is shown in Figure 2.6. There are around 200 members in the Central Committee, above which is the Political Bureau of the Central Committee, consisting of around 25 Central Committee Members. Above the Political Bureau, there is a Standing Committee of the Political Bureau, consisting of 5-9 Political Bureau Members. Most Provincial Party Secretaries from the thirty-one provinces of mainland China are Central Committee Members. The Secretaries from a small number (less than five) of politically or economically influential provinces, e.g. Beijing and Shanghai, are Political Bureau Members, but are outside the Standing Committee.

In the Mao period, the evaluation of provincial leaders is based on political considerations. Since the reform, economic performance has become the main criterion for the promotion of the provincial leaders. Specifically, provincial leaders with a better economic performance have a higher chance of being promoted. Maskin, Qian and Xu (2000) are the first to notice this. Li and Zhou (2005) provide the first systematic study of the promotion rule. They show that the probability of promotion (termination) of provincial leaders increases (decreases) with the average economic performance in the past term, measured in the annual GDP growth rate. In a follow-up study, Chen, Li and Zhou (2005) further show that the promotion probability of the provincial leaders is also affected by the performance of their immediate predecessors, as this can reduce the noise in the evaluation. The relative economic performance evaluation also holds at lower levels of the hierarchy[1]. Edin (2003) conducts a field study about the relative economic performance evaluation and promotion of leaders at the city and township levels. Li (2009) shows that prefectures with a higher growth are more likely to be upgraded to cities and the ranking of the corresponding leaders will be upgraded simultaneously. Summing up, there is ample evidence of yardstick competition of economic

[1]The structure of China's geographical hierarchy is as follows: Center–Province–City–Township–Village.

growth among Chinese local leaders.

Figure 2.6: The Party Hierarchy



The relative economic performance based evaluation system is essential for China's high growth. In a comparative study of China and Russia, Blanchard and Shleifer (2001) argue that China's evaluation system, which is absent in Russia, is essential for the sharp difference in the economic performance of the two countries after the decentralization reform.

2.2.3 Inflation and Investment Control

China's incentive system is not costless, however. Since the evaluation is based on the provincial leader's performance in the past term and the promotion is associated with more power, more privilege and a better career chance, the provincial leaders have strong incentives to stimulate economic growth (i) *only* within the regions under their own governance; and (ii) *only* within their term, which is just five years. The former point leads to local

protectionism[1] and the latter to a conflict of interest between the central government and the local leaders as concerns inflation. The conflict of interest is essential to explain the mechanism of China' political cycles. Under the incentive structure, the local leaders always try to maximize the short-run growth. But their behavior is not unbounded. To use the terminology of Kornai (1992), the investment hunger is constrained by the supply capacity of the economy, such as the physical capacity of the consumption goods sector and the investment goods sector, and the balance of payments and foreign debts. Furthermore, when the price is kept fixed, the tension between investment demand and supply capacity is reflected in economic shortage. When the price is flexible, the tension is reflected as inflation.

Kornai's theory applies perfectly to China. In Figure 2.7, we plot the time series of inflation calculated based on the GDP deflator, and gross capital formation growth before 1976. In this period, prices are kept fixed and artificially low. The inflation rate is almost constant at zero and does not respond to gross capital formation growth.[2]

In Figure 2.8, we plot the two series after 1976 when China's central government starts the market reform and gradually relaxes the control of prices. Inflation corresponds very well to gross capital formation growth.

When inflation increases, the central government bears the cost, in particular involving political instability. For example, inflation is widely regarded as a key factor behind the student protest in 1989. Different top leaders in China state many times that "Inflation (in China) is not only simply an economic problem, but a political one" (Huang 1996). When inflation increases too much, the central government intervenes by carrying out a so-called "Macro Adjustment and Control" program. As mentioned in the introduction, capital

[1]See Young (2001) for evidence at the aggregate level, Bai et al. (2004) for evidence at the industry level and Dollar and Wei (2005) for evidence in the banking sector.

[2]See Naughtons (1986, 1987) for studies on the shortage of consumption goods and investment growth in China before the reform.

formation growth decreases dramatically during such an intervention.[1]

Figure 2.7: Gross Capital Formation Growth and Inflation before 1977

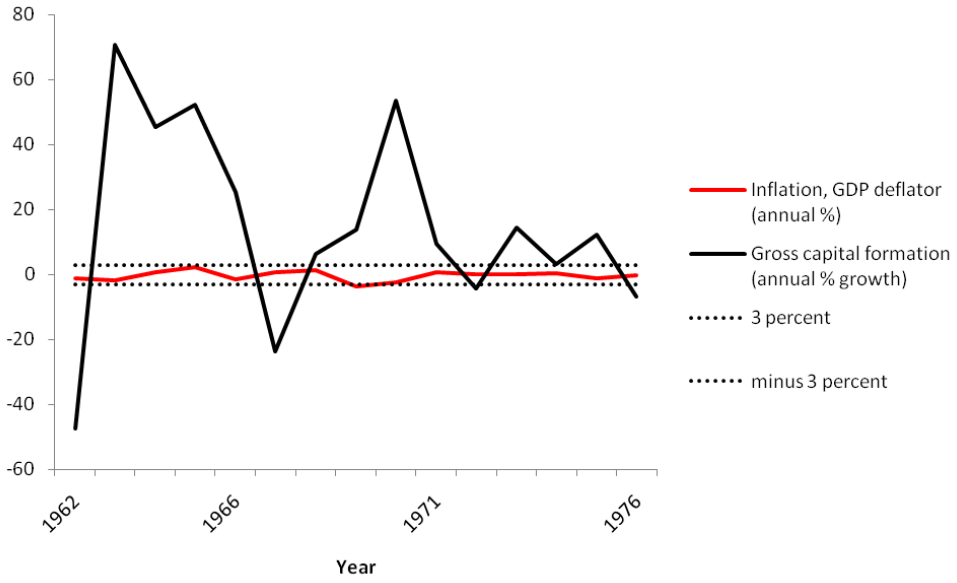
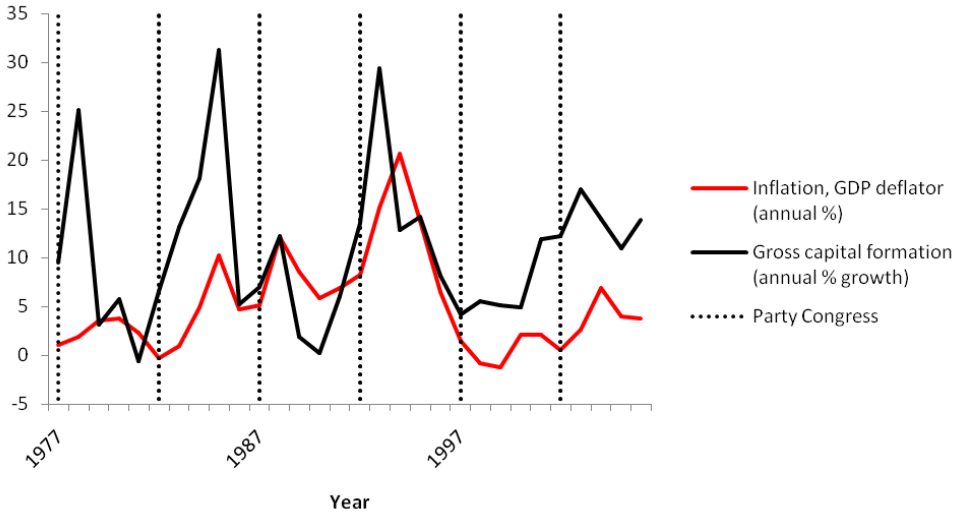


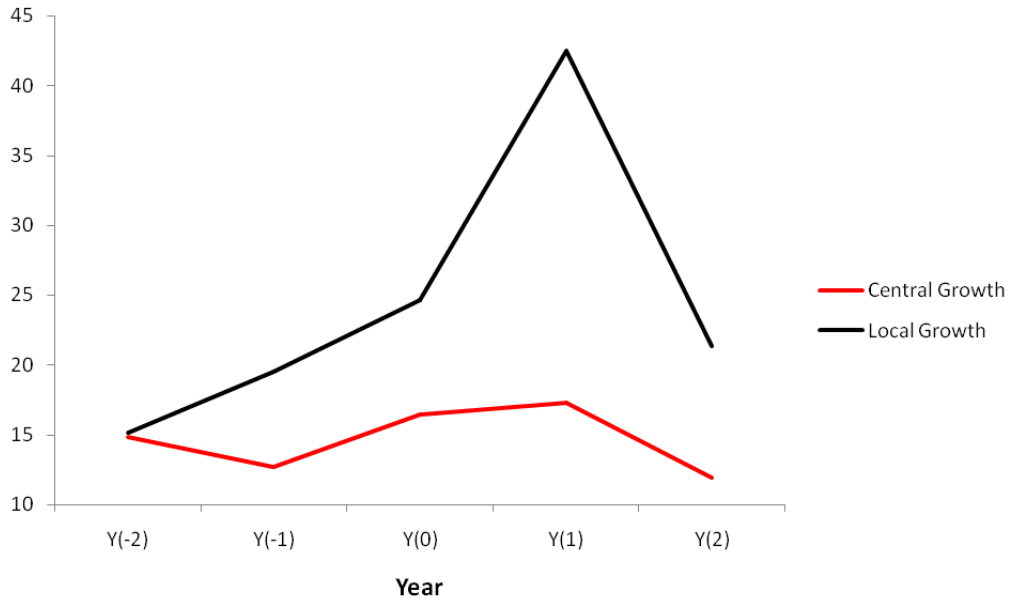
Figure 2.8: Gross Capital Formation Growth and Inflation after 1977



[1]See Huang (1996) for a detailed study of these interventions.

The conflict of interest between the central government and the provincial leaders on inflation translates into different preferences as concerns the pattern of growth. The central government prefers a relatively high and stable growth with low inflation, while the provincial leaders prefer high growth, without caring about the inflation. After 1976, the central government gradually decentralizes most of the (civil) investment approval power to the provincial government, but not all. Around 20% of the (civil) investment need to be approved by the central government. In Figure 2.9, we plot the average

Figure 2.9: Gross Capital Formation Growth and M2 Growth



growth rates of fixed asset investment[1] administered by the local government and the central government around the party congress. The investment

[1]Fixed asset investment is an accounting item in the statistical system of a central planned economy. It measures all resources that are expended **on** fixed capital while capital formation measures the part of GDP that is expended **on** capital. In China Statistical Yearly Books, there is detailed information about the investment projects that are administrated by the central government and the local government, while the data on gross capital formation does not contain any such information. Administration means project approval.

administered by the local government has the same growth pattern as the political cycle, while the investment project administered by the central government shows an almost constant average growth. This reveals the divergent preference of the central government and the provincial leaders.

2.3 The model

Consider a three-period economy with a mass $1+n$ of regions indexed by $i \in [0,1]$. In the economy, there is a hierarchy composed of a principal and a mass $1+n$ of agents. The principal and the agent stand for the central government and the regional leader, respectively. The task of each regional leader is to manage the production of one region for the central government. There is no discounting in the three periods.

2.3.1 The Central Government and Production

There is production and inflation in periods 1 and 2, where the central government values growth and dislikes inflation. At the end of period 2, a mass $m < 1$ of regional leaders is promoted to the central government. In period 3, the central government only derives utility from the competence of the promoted regional leaders. This is a simple way of representing the interest of the government in hiring the most competent leaders at the central level. Formally, the central government's utility function in each period is

$$V_t = aG_t - b\pi_t^2 \text{ for } t = 1 \text{ and } 2, \tag{2.1}$$

and

$$V_3 = c\int_0^m \theta_j dj \tag{2.2}$$

where $G_t = \int_0^{1+n} g_{it}di$, π_t is the inflation of period t and θ_j denotes the competence of the promoted leader from region j,

If there is no intervention by the central government, which we will explain later, the growth in region i is as follows

$$g_{i1} = g_{i2} = \theta_i + s_i, \tag{2.3}$$

where g_{it} denotes the growth of region i in period $t \in \{1, 2\}$, θ_i and s_i are the competence and short-run growth stimulus chosen in period 1 by the local leader in region i, respectively.

2.3.2 The Regional Leaders

Competence is a permanent feature of each regional leader. At the beginning of period 1, nature randomly chooses the competence of the leader in each region from a normal distribution (c.d.f Φ and p.d.f ϕ) with mean $\bar{\theta}$ and variance σ_θ^2. Following Holmström (1982), we assume that the competence is initially unknown to the central government as well as the regional leader himself, and only the distribution of competence is shared by everyone in the game.

The short-run growth stimulus s_i is a hidden action of each regional leader i and affects the growth in the first two periods. Exerting s_i involves a private cost $\frac{\lambda_i s_i^2}{2}$ of the regional leader i. λ_i is also determined by nature, independent with θ_i and from a normal distribution with mean $\bar{\lambda}$ and variance σ_λ^2. The value of λ_i is only privately known by regional leader i and the distribution of λ_i is common knowledge.

The regional leaders' income in periods 1 and 2 is normalized to zero. In the third period, a promoted regional leader gets the promotion rent R and an unpromoted regional leader's income is once more normalized to zero. We assume that a mass 1 of regional leaders are eligible to be promoted and the remaining n leaders are not. The knowledge of eligibility is shared by everyone.

We make the following assumption about the distribution of growth con-

ditional on competence.

Assumption 1: $f(g|\theta)$ has a Monotone Likelihood Ratio Property (MLRP)[1], where f is the density of g conditional on θ. That is, for all $g_1 > g_2$ and $\theta_1 > \theta_2$,

$$\frac{f(g_1|\theta_1)}{f(g_1|\theta_2)} > \frac{f(g_2|\theta_1)}{f(g_2|\theta_2)}$$

The intuition of the MLRP assumption is that when competence is higher (lower), the corresponding growth rate is more likely to be higher (lower). As it will turn out, this assumption leads to the fact that a regional leader with a higher growth rate is expected to have a higher competence, which the central government values for the promoted leaders. This gives the eligible regional leaders the incentive to exert the costly stimulus to seem more competent in order to increase the promotion probability.

2.3.3 Inflation and Intervention

Inflation at the beginning of period 1 is normalized to zero. At the end of period 1, inflation is

$$\pi_1 = \int_0^1 s_i di + \delta_1 \tag{2.4}$$

where s_i is the stimulus by the local leader in region i, δ_1 is a shock realized in period 1, distributed in the range $\left[-\bar{\delta}, \bar{\delta}\right]$ with the cumulative distribution function Ψ and the probability density function ψ.

At the end of period 2, if there is no intervention, inflation is

$$\pi_2 = \pi_1 \tag{2.5}$$

The central government can intervene by centralizing the power to reduce inflation. Intervention can take place at the beginning of periods 1 or 2. With an intervention, the growth of any region in the intervention period is equal

[1]See Milgrom (1981) for a detailed discussion of the MLRP.

to a low level

$$g_i^I = w \text{ for all } i$$

and inflation at the end of the intervention period is normalized to zero. w can be regarded as the growth stimulus by the central government at the intervention period. A lower w reflects a higher intervention cost.

2.4 Equilibrium

Before proceeding, we make an assumption to keep our analysis simple and non-trivial.

Assumption 2: For the central government, decentralizing in period 1 and retaining the power to intervene in period 2 (timing 1) always dominates intervention in both period 1 and period 2 (timing 2).[1]

Assumption 2 rules out the possibility of intervention in both periods. Compared to timing 2, timing 1 has two benefits: (i) higher growth in periods 1 and 2; and (ii) higher expected competence of the promoted leaders in period 3 due to the fact that the central government can extract the signal of local leaders' competence from their output. The cost of timing 1 is higher inflation in periods 1 and 2. Other things given, timing 1 dominates timing 2 when the intervention cost is high (low w), the disutility of inflation is low (low b), the value of growth is high (high a) and the value of the promoted leaders' competence is high (high c). To make our analysis non-trivial, we focus on the set of parameters when assumption 2 holds.

By assumption 2, the central government can only intervene in period 2. Inflation in period 2 can be written as

$$\pi_2 = (1 - I)\,\pi_1 + I * 0 \tag{2.6}$$

[1] We figure out this assumption mathematically in the appendix.

and the growth rate of region i in period 2 can be written as

$$g_{i2} = Iw + (1 - I)\, g_{i1}, \tag{2.7}$$

where I is the indicator of intervention.

With the description of the economy and the assumptions, the timing of the events in the three periods can now be summarized as follows:

1. At the beginning of period 1, nature determines the competence θ_i, the stimulus cost λ_i and the eligibility for the leader in each region i.
2. Each regional leader chooses s_i.
3. δ_1 is realized.
4. Growth and inflation in period 1 are realized
5. The economy moves to period 2.
6. The central government makes the intervention decision.
7. Growth and inflation in period 2 are realized.
8. The central government makes the promotion decision.
9. The economy moves to period 3.

2.4.1 The Ineligible Regional Leaders

The regional leaders ineligible for promotion obviously have no incentive to exert the costly stimulus to signal their competence. Therefore, they choose zero stimulus and the growth rates in the regions with such leaders are only affected by the regional leaders' competence and intervention. Unless otherwise noted, we will focus on the behavior of the eligible regional leaders in this section.

2.4.2 The Eligible Regional Leaders

When choosing s_i, each eligible regional leader remains ignorant of his own competence θ_i and aware of the stimulus cost λ_i and the eligibility for promotion. Formally, the expected utility of region $i's$ leader is

$$U_i = \Pr(promotion)R - \frac{\lambda_i s_i^2}{2}$$

The equilibrium behavior of the eligible regional leaders can be solved by backward induction.

2.4.2.1 Time-Consistent Promotion Rule

As promotion takes place after inflation and growth have been realized, the central government, ex post, always has an incentive to promote the eligible leaders with the highest expected competence. The time-consistent promotion rule is that the top m eligible leaders in terms of the expected competence are promoted.

When estimating θ_i, the central government faces a signal extraction problem. Specifically, the central government observes the growth of each region in the first two periods and based on this, it makes an estimation about the competence of each regional leader. Note that (see equation 2.7) given the assumptions that (i) without intervention, g_{i2} equals g_{i1}; and (ii) with intervention in period 2, g_{i2} equals to w for all i, the first period growth g_{i1} is sufficient for the central government to estimate θ_i, as g_{i2} does not add any new information for the estimation.

By the Monotone Likelihood Ratio Property of $f(g|\theta)$, we have the following proposition of the signal extraction.

Proposition 1. ***The expected competence of a local leader strictly increases with his growth in the first period.***

Proof. **See the appendix.** ■

The intuition of proposition 1 is as follows. The MLRP assumption implies that when a regional leader's competence is higher, his growth rate is more likely to be higher. Knowing this, whenever there is an increase in the growth rate, the central government at least attributes part of the increase in growth to the increase in competence.

By proposition 1, the time-consistent promotion rule is that the eligible regional leaders with top m growth rates in the first period are promoted. Formally

$$P_i = \begin{cases} 1 & \text{if} \quad rank(g_{i1}) \leq m \\ 0 & \text{if} \quad rank(g_{i1}) > m \end{cases}$$

where P_i is an indicator of promotion.

2.4.2.2 Equilibrium Stimulus

Denote the CDF and PDF of equilibrium g_{i1} of the eligible regional leaders as $F(g)$ and $f(g)$, respectively. By the law of large numbers, the threshold level of first period growth for promotion converges to a fixed point $\bar{g}$ with

$$\bar{g} = F^{-1}(1-m)$$

The promotion probability for the eligible regional leader in region i is

$$\begin{aligned} & \Pr\left[g_{i1} \geq \bar{g}\right] \\ = \; & \Pr\left[\theta_i + s_i \geq \bar{g}\right] \\ = \; & \Pr\left(\theta_i \geq \bar{g} - s_i\right) \\ = \; & 1 - \Phi\left(\bar{g} - s_i\right), \end{aligned}$$

where Φ is the CDF of the competence.

The eligible local leader in region i takes $\bar{g}$ as given and solves the following

maximization problem

$$\max_{s_i} \Pr\left[1 - \Phi\left(\bar{g} - s_i\right)\right] R - \frac{\lambda_i s_i^2}{2}$$

Taking the first-order condition with respect to s_i

$$\phi\left(\bar{g} - s_i\right) R = \lambda_i s_i \tag{2.8}$$

where ϕ is the PDF of the normal distribution.

The LHS of (2.8) is the marginal benefit of a change of s_i and the RHS is the marginal cost of the change. Other things given, an increase of R leads to an increase in the marginal benefit and thus an increase of s_i. An increase of λ_i leads to an increase in the marginal cost and therefore leads to a decrease of s_i.

The change of m has two effects on s_i. Suppose that there is a decrease of m (less vacancies at the center), competition among all local leaders becomes tougher and $\bar{y}$ increases. This will increase the stimulus of all local leaders and we call this the competition effect. On the other hand, the marginal benefit of increasing s_i to appear more competent may not increase, as the absolute probability of promotion falls with the decrease of m. We call this second effect the promotion risk effect. The directions of the two effects may not be the same and therefore the effect of m on s_i is ambiguous. However, when m equals zero or one, the LHS of (2.8) becomes zero and s_i equals zero in these two cases. Intuitively, the local leaders have no incentive to signal their competence when the promotion probability is zero or one. Summing up the analysis, we have the following propositions:

Proposition 2. s_i ***increases with*** R ***and decreases with*** λ_i.

Proposition 3. $s_i = 0$ ***when*** $m = 0$ ***or*** 1 ***and*** s_i ***is maximized at a point where*** $m \in (0, 1)$.

2.4.3 Equilibrium Inflation, Intervention and Output Dynamics

As we have shown, intervention does not affect the local leaders' estimated competence. This implies that the central government's utility in period 3 is not affected by intervention. Therefore, when making the intervention decision, the central government's utility in period 2 is the only determinant of intervention.

By the law of large numbers, total output across regions in period 1 is

$$Y_1 = \bar{\theta} + \bar{s}$$

where $\bar{s}$ is the mean of the equilibrium s_i

$$\bar{s} \equiv \int s_i(R, m, \lambda_i) d\lambda_i$$

Inflation in period 1 is

$$\pi_1 = \bar{s} + \delta_1$$

If there is no intervention, total output across regions in period 2 is

$$Y_2 = Y_1 = \bar{\theta} + \bar{s}$$

and inflation in period 2 is

$$\pi_2 = \pi_1 = \bar{s} + \delta_1,$$

In this case, the utility of the central government in period 2 is

$$V_2 = a\left(\bar{\theta} + \bar{s}\right) - b\pi_1^2.$$

If there is intervention in period 2, total output in period 2 is w and inflation

is zero. In this case, the utility of the central government in period 2 is

$$V_2^I = aw.$$

Denote the threshold level of period 1 inflation for intervention as $\bar{\pi}$, which can be solved by equalizing V_2^I and V_2 :

$$\bar{\pi} = \sqrt{\frac{a\left(\bar{\theta} + \bar{s} - w\right)}{b}}$$

The equilibrium intervention rule is

$$I\left(\pi_1\right) = \begin{cases} 0 & \text{if} \quad \pi_1 < \bar{\pi} \\ 1 & \text{if} \quad \pi_1 \geq \bar{\pi} \end{cases}$$

where I is the indicator of intervention.

The equilibrium probability of intervention is

$$\begin{aligned} prob\left(\pi_1 > \bar{\pi}\right) &= prob\left[\bar{s} + \delta_1 > \bar{\pi}\right] \\ &= 1 - G\left[\bar{\pi} - \bar{s}\right]. \end{aligned}$$

Simple algebra will establish the following proposition:

Proposition 4. ***Output and inflation in period 1 are*** $\bar{\theta} + \bar{s}$ ***and*** $\bar{s} + \delta_1$***, respectively. With probability*** $G\left[\bar{\pi} - \bar{s}\right]$***, there is no intervention and output and inflation in period 2 are*** $\bar{\theta} + \bar{s}$ ***and*** $\bar{s} + \delta_1$***, respectively. With probability*** $1 - G\left[\bar{\pi} - \bar{s}\right]$***, there is intervention and output and inflation in period 2 are*** w ***and*** 0***, respectively.***

Note that the economy starts with zero stimulus and zero output. In period 1 the equilibrium growth stimulus in every region is s^*. In period 2, the stimulus is either s^* or w, depending on whether there is an intervention. s^* can be seen as a measure of the political business cycle and therefore, the comparative statics of s^* with respect to R, λ and m also applies to the

magnitude of the cycle.

2.5 Empirical test

Our model predicts that the size of the political cycle is affected by three factors. In this section, we first describe our data. Then, we will test the predictions of the model with a panel of provincial data.

2.5.1 Data and Measurement

We will test our theory with provincial level data in the period 1983 to 2007, which covers five terms of the Provincial Party Secretaries. Our provincial data of capital formation growth is from the Database of China Data Center at University of Michigan. There are currently 31 provinces in mainland China. Two provinces were constructed after 1983 (the province of Hainan in 1988 and the province of Chongqing in 1997). We drop these two provinces in our analysis. We also drop Tibet because of the unavailability of data for the complete period. Our data on the background of Provincial Party Secretaries is from public sources.

2.5.1.1 Proxies of Stimulus Cost

There are four types of firms in China: state-owned, collectively-owned, private and foreign. The collectively-owned firm is owned by a group of people but effectively controlled by the local government. We construct three proxies for the stimulus cost of local leaders. Our first proxy, denoted as $state\_output\_ratio_{it}$, is defined as the ratio of output by state-owned and collectively-owned firms over total output in province i at year t. It measures the relative size of the firms that can easily be manipulated by the provincial leaders in terms of output. Correspondingly, we define two other variables, $state\_labor\_ratio_{it}$ and $state\_fai\_ratio_{it,}$ to proxy the manipulation cost in

terms of labor and fixed asset investment.

2.5.1.2 The Size of Promotion Rent

We test the effect of promotion rent on the size of the political cycle in two ways.

First, we define RPL_{it} as a measure of the Provincial Party Secretary's remaining political life. It equals 65 minus the age of province i's Party Secretary in the next Central Party Congress after year t. Since younger leaders care more about the future and have a higher promotion rent, we expect the size of the political cycle to be positively related to our measure of age. As the RPL does not change within one term, we will cluster the errors of our estimated coefficients at the provincial level.

Second, we use an exogenous source of variation in the value of the promotion rent that comes from the mandatory retirement rule. Before 1982, Chinese leaders typically held power till death and there was no rule for the retirement age. In 1982, the central government set 65 to be the mandatory retirement age for the leaders at the provincial level and a massive replacement of old leaders took place after the announcement of the rule. Note that although the mandatory retirement age for leaders at the provincial level is set at 65, there is no clear rule for the retirement age of leaders in the Political Bureau. This implies that if a Provincial Party Secretary cannot be a member of the Political Bureau before 65, he must retire at the age of 65. Given this fact, RPL_{it} measures how many years province i's incumbent Party Secretary at year t can work as a leader at the provincial level after the upcoming Central Party Congress. For example, the next Central Party Congress will be held in 2012. If the age of province $i's$ party secretary is 60 in 2009, then his age in 2012 will be 63 and he can be a leader at the provincial level for another two years after the Congress. Thus, $RML_{i2009} = 2$. While if RPL_{it} is negative, the Provincial Party Secretary must retire before the next Central Party Congress and is therefore a lame duck. We expect that the

size of the political cycle of a lame duck is smaller than that of a Provincial Party Secretary with the chance for promotion. This is in the spirit of Besley and Case (1996).

Based on the mandatory retirement rule, we define a dummy variable $young_{it}$ to indicate whether the Provincial Party Secretary at Province i in year t has a promotion chance:[1]

$$young_{it} = \begin{cases} 1, & \text{if} \quad RPL_{it} \geq 0 \\ 0, & \text{if} \quad RPL_{it} < 0 \end{cases}$$

2.5.1.3 Proxies for the Number of Vacant Seats in the Political Bureau

The number of vacant seats at the Political Bureau cannot be fully forecasted before every Congress for two reasons. First, the total number of seats is not fixed at every Congress. Second, there is no clear rule about the retirement age of the members of the Political Bureau. We use the number of new leaders who are promoted to the Political Bureau in each Congress to proxy the number of vacant seats at the Bureau before each Congress. Implicitly, we assume that all local leaders have rational expectations about the number of vacant seats before the Congress.

2.5.2 Empirical Strategy and Results

The specification of our test takes the following form

$$g_{it} = \theta_i + v_T + X_{it} + peakyear_t + X_{it}peakyear_t + \epsilon_{it}.$$

[1] As mentioned, the mandatory retirement rule only applies to the leaders at the provincial level, while a limited number of Provincial Party Secretaries are members of the Political Bureau. Such Provincial Party Secretaries are not affected by the retirement rule and we do not treat them as lame ducks, even when their RPL is negative.

g_{it} is province $i's$ real capital formation growth in year t. θ_i is the province fixed effect. To avoid convoluting shocks, we also control for the term fixed effect v_T in the regression. X_{it} is the determinant of the size of the political cycle. $peakyear_t$ is an indicator of the first year after the Party Congress. We will be interested in the estimated coefficients of the interaction term. ϵ_{it} is the error. In all subsequent tests, we estimate robust standard errors adjusted for clustering at the province level.[1]

In column 1 of table 2.1, we report the size of the political cycle during 1983-2007. On average, real capital formation growth is 7.3 percentage points higher in peak years than in the other years. This difference is significant at 1%. In columns 2, 3 and 4 of table 2.1, we report the estimation for the effect of the stimulus cost on the size of the political cycle. Our estimates are not only statistically significant, but also economically important. For example, column 2 shows that privatizing roughly 50% of the firms in terms of output can completely eliminate the political cycle, at least from the yearly data. This is consistent with the evidence at the national level. The massive privatization starts in 1997 and the size of the political cycle indeed becomes much smaller than before (see Figure 2.1).

In column 1 of table 2.2, we report the estimation for the effect of the remaining political life on the size of the political cycle. This effect is quantitatively large but only significant at 10%. In columns 2, 3 and 4 of table 2.2, we control for the stimulus cost in the regression. The estimated coefficient for RML_{it} increases slightly and becomes significant at 5%. The reason for this change is as follows. The size of the political cycle is large (see Figure 2.1) in the early years during which the stimulus cost is relatively low. Moreover,

[1]One concern about the errors is that they may be correlated across time for two reasons. First, intervention by the central government affects all provinces simultaneously. Second, the rational expectation for the number of vacant seats at the center affects the behavior of all Provincial Party Secretaries within the same term. We report our results separately in Tables 2.5-2.8I in the Appendix,with two-way clustered errors which can be regarded as a sensitivity test. The significance levels of all estimated coefficients are only affected slightly.

Table 2.1: Stimulus Cost and the Magnitude of the Cycle

Dependent Variable	Real Capital Formation Growth			
	(1)	(2)	(3)	(4)
peakyear	0.073***	-0.043	-0.244***	-0.128***
	(0.010)	(0.026)	(0.055)	(0.036)
sc_output_ratio		-0.053		
		(0.034)		
sc_output_ratio*peakyear		0.167***		
		(0.032)		
sc_labor_ratio			0.077	
			(0.055)	
sc_labor_ratio*peakyear			0.345***	
			(0.060)	
sc_fai_ratio				-0.070*
				(0.063)
sc_fai_ratio*peakyear				0.280***
				(0.054)
Province fixed effect	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES
R-squared	0.217	0.248	0.241	0.237

Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level and at the year level.

* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

there are more old leaders in the early years. If we do not control for the stimulus cost as in column 1 of table 2.2, the estimation will be downward biased, as if old leaders generate a larger size of political cycle. Once the stimulus cost has been controlled for, a clear picture emerges. On average, if the remaining political life increases by one year, the size of the political cycle increases by 0.6 percentage points, which is equivalent to 8.2% of the difference in growth rates between peak years and the other years.

In table 2.3, we report our estimation for the effect of a lame duck on the size of the political cycle. In column 1, we show that the effect is quantitatively large but insignificant when we only include the lame duck factor in the regression. In columns 2 and 3, the estimate coefficient for the lame duck effect becomes larger and significant on the margin of 5% when we control for the stimulus cost in terms of output and labor. There is a discontinuity in the size of the political cycle at the age of 65. The size of the discontinuity is roughly 5 percentage points, equivalent to 68.5% of the difference in growth rates between the peak years and the other years. In column 4, the estimated coefficient for the lame duck effect is also larger than that of column 1 and it is marginally significant at 10%.

In table 2.4, we report the estimation for the effect of the number of central seats on the size of the political cycle. In column 1, we estimate the linear relationship. The estimated coefficient is quantitatively large and significant at 1%. In column 2, we include the interaction between the square of the number of central vacant seats and the peak year. The results show that there is an inverted U relationship between the number of vacant seats at the central government level and the size of the political cycle. Specifically, the size of the political cycle is largest when there are 13 vacant seats, roughly 50% of the total number of Political Bureau Members, and it becomes smaller when the number of vacant seats increases or decreases. In Figure 2.10, we plot the number of vacant seats on the X-axis and real capital formation growth in the peak years on the Y-axis. We can clearly see the inverted-U

Table 2.2: Remaining Political Life and the Magnitude of the Cycle

Dependent Variable	Real Capital Formation Growth			
	(1)	(2)	(3)	(4)
peakyear	0.059***	-0.061**	-0.281***	-0.162***
	(0.012)	(0.025)	(0.047)	(0.039)
rpl	-0.002**	-0.002**	-0.002**	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
rpl*peakyear	0.005*	0.006**	0.006**	0.006**
	(0.003)	(0.002)	(0.002)	(0.003)
sc_output_ratio		-0.055*		
		(0.033)		
sc_output_ratio*peakyear		0.171***		
		(0.028)		
sc_labor_ratio			0.069	
			(0.057)	
sc_labor_ratio*peakyear			0.369***	
			(0.050)	
sc_fai_ratio				-0.073
				(0.061)
sc_fai_ratio*peakyear				0.305***
				(0.053)
Province fixed effect	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES
R-squared	0.226	0.26	0.253	0.25

Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level and at the year level.

* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

Table 2.3: Lame Duck and the Magnitude of the Cycle

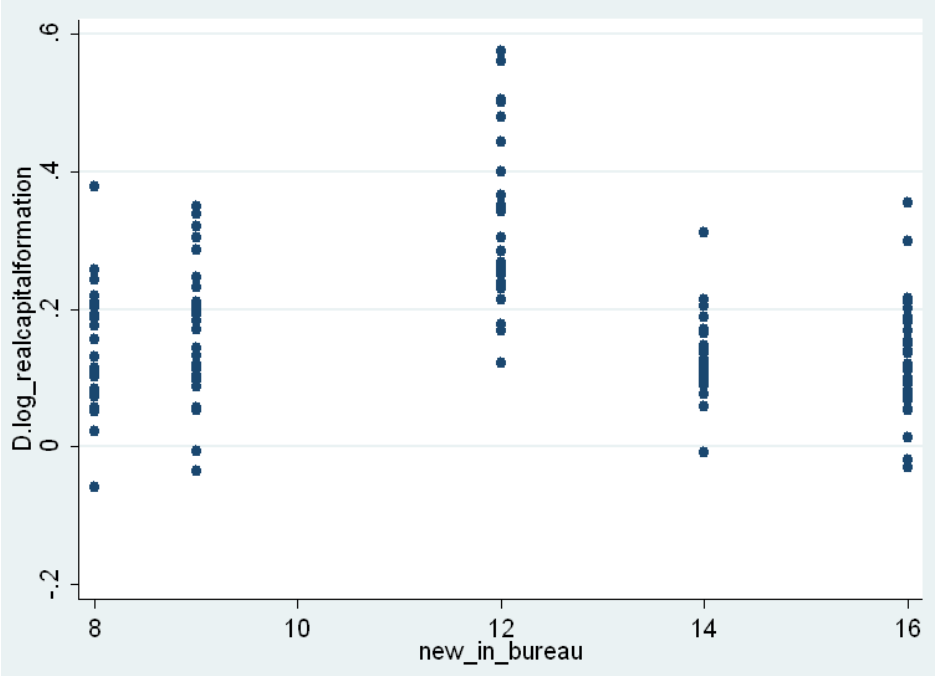
Dependent Variable	Real Capital Formation Growth			
	(1)	(2)	(3)	(4)
peakyear	0.049*	-0.089**	-0.307***	-0.167***
	(0.025)	(0.038)	(0.063)	(0.047)
young	-0.02	-0.029*	-0.022	-0.025
	(0.017)	(0.016)	(0.017)	(0.017)
young*peakyear	0.031	0.051*	0.049*	0.04
	(0.028)	(0.026)	(0.027)	(0.026)
sc_output_ratio		-0.066**		
		(0.032)		
sc_output_ratio*peakyear		0.178***		
		(0.033)		
sc_labor_ratio			0.068	
			(0.058)	
sc_labor_ratio*peakyear			0.373***	
			(0.060)	
sc_fai_ratio				-0.082
				(0.064)
sc_fai_ratio*peakyear				0.290***
				(0.054)
Province fixed effect	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES
R-squared	0.22	0.255	0.247	0.242

Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level and at the year level.

* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

relationship between the two variables in the raw data.

Figure 2.10: The Number of Central Vacancies and the Growth in Peak Years



In the remaining columns of table 2.4, we include all determinants for the size of the political cycle in our model in the regressions. In columns 3-5 (6-8), we estimate the effect of the remaining political life (lame duck), the stimulus cost with our three respective proxies and the number of vacant central seats on the size of the political cycle. When we include all determinants predicted in our model for the size of the political cycle in the regression, all estimated coefficients have the right signs, which are quantitatively large, and they are all significant at least at 5%.

Table 2.4: The Number of Central Seats and the Magnitude of the Cycle

Dependent Variable	Real Capital Formation Growth							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
peakyear	-0.028	-1.002***	-0.783***	-1.026***	-0.980***	-0.906***	-1.144***	-1.092***
	(0.037)	(0.178)	(0.183)	(0.170)	(0.172)	(0.197)	(0.193)	(0.197)
RPL			-0.002**	-0.002**	-0.002**			
			(0.001)	(0.001)	(0.001)			
RPL*peakyear			0.0057**	0.0057**	0.006**			
			(0.003)	(0.003)	(0.003)			
young						-0.032*	-0.026	-0.029
						(0.017)	(0.017)	(0.018)
young*peakyear						0.059**	0.058**	0.054**
						(0.026)	(0.026)	(0.025)
sc_output_ratio			-0.05			-0.061*		
			(0.035)			(0.035)		
sc_output_ratio*peakyear			0.115***			0.117***		
			(0.039)			(0.040)		
sc_labor_ratio				0.084			0.084	
				(0.055)			(0.057)	
sc_labor_ratio*peakyear				0.221***			0.218***	
				(0.065)			(0.068)	
sc_fai_ratio					-0.044			-0.052
					(0.063)			(0.066)
sc_fai_ratio*peakyear					0.191***			0.169**
					(0.068)			-0.066
number of seats*peakyear	0.009***	0.184***	0.134***	0.153***	0.156***	0.150***	0.168***	0.174***
	(0.003)	(0.031)	(0.032)	(0.031)	(0.031)	(0.033)	(0.032)	(0.033)
number of seats_square*peakyear		-0.007***	-0.006***	-0.006***	-0.006***	-0.006***	-0.007***	-0.007***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Province fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.226	0.255	0.274	0.273	0.272	0.267	0.271	0.269

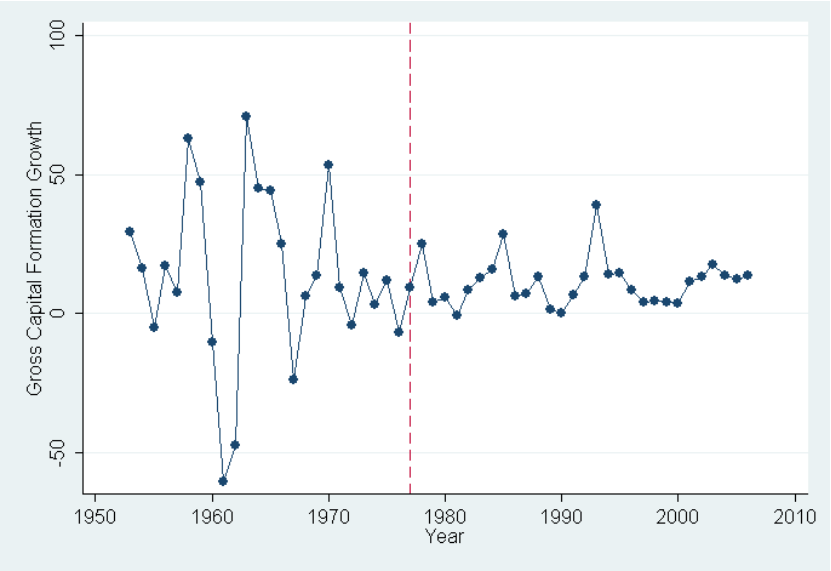
Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level.
* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

2.6 Related literature

Our theory is related to the investment cycle theory in the Central Planned Economy (Goldmann and Kouba 1969; Oliveira 1960; Kornai 1980; and Bauer 1978, 1988). The main idea of the CPE investment cycle theory is that top leaders in socialist countries are eager to catch up with capitalist countries and therefore stimulate growth whenever possible. When the stimulus is constrained by the production capacity of the bottleneck sectors, the growth rate goes down and when the production capacity recovers, a new round of stimulus begins. Like the investment theory, we show the cause of Chinese inflation after 1976 to be driven by investment growth. But unlike this theory, we show that (i) with the decentralization reform, instead of the central government driven by the catching-up ideology, the career concern motivated local leaders should account for the economic overheating; (2) with the institutional reform of regular leader change, the timing of the business cycle corresponds to the Party Congress. The difference between the investment cycle theory and our theory can best be illustrated in Figure 2.11, which plots China's gross capital formation growth since the 1950s, with the red dashed line indicating the year 1977. While regular leader changes since 1977 make the timing of the cycle predictable, market reform makes the price a better signal of economic shortage, based on which the central government can intervene at an earlier stage. Therefore, we can clearly see that the magnitude of the cycle becomes smaller after 1976. Moreover, the graduate ownership reform after 1997 makes it harder for the local leaders to manipulate the economy and the magnitude of the cycle after 1997 is shrinking.

Regarding the studies on China' growth fluctuations, a small literature notes the stop-go feature of the Chinese economy, but without relating the feature to politics (e.g. Brandt and Zhu 2000, Imai 1994). Zou (1994) is the first to relate the timing of the growth fluctuation to political events, but not to the Party Congress. This study argues that the business cycle is the result of a power struggle in the central government and is driven by leaders'

Figure 2.11: Capital Formation Growth before and after 1977



ideology. Specifically, there is an economic boom when the pro-capitalism reformists hold the economic planning power and the economic downturn is due to the fact that the dogmatic adherents of socialism seize the power from the reformists. Zou's study is problematic in the following three respects. First, it is based on anecdotal evidence rather than systematic empirical evidence as in our study. Second, combining Zou's theory with our finding of the correspondence between the timing of the Party Congress and the business cycle, it is very hard to explain why the pro-capitalism central leaders always get power in the first year after the Party Congress and always lose power in the following year. Third, before 1992, there was a debate at the central level about the necessity of reform. But after Deng's 1992 Southern tour, reform becomes the consensus of the whole Party (see e.g. Song, Storesletten and Zilibotti 2011 for a brief description). However, the pattern of the political business cycle still holds after 1992, which is inconsistent with Zou's theory.

Hu (1994) is the only study[1] to notice the correlation between the GDP growth rate and Party Congress when applying the investment cycle theory in CPE to explain China's growth fluctuation after 1949. Using Hu's terminology, high growth follows the "political mobilization shock", which involves an expansionary policy from the central government, while the stagnation is due to the "political order shock", which involves a contractionary policy from the central government. When studying the growth fluctuation in the post Mao period (1977-1993, see Figure 2.12), Hu finds that China's GDP growth rates in this period are most likely to peak in either the Party Congress Year (1987 and 1992) or in the first year after the Party Congress Year and, on average, there is a jump in the GDP growth rate in the Party Congress Year (Figure 2.13).

Hu argues that this occurs due to the fact that after 1976, the central government initiates the "political mobilization" of expansion at the regular Party Congress and then the central government changes to the "political order" of contraction when the economy is overheated. Hu's explanation is problematic in the following respects. First, since every Party Congress is held near the end of the year, the "political mobilization", if it exists, should only account for the increase in the GDP growth rate after the Congress Year, but not the increase in the Congress year. Second, there is one Plenum of the Central Committee every year and many important decisions are made in the Plenum. If the "political mobilization" needs the consensus of the Central Committee, the central government can initiate it in any year and the Party Congress year may not always be the right point in time. Third, there has indeed been no "political mobilization" in the Party Congresses held after 1976. The focus of the Party Congress is the Party's political issues, among which leader change is the most important. The major economic issues are

[1]There are two informal articles with the same idea of Hu (1994) by someone at a Japanese institute. The links are as follows:
1) http://www.rieti.go.jp/en/china/04071401.html
2) http://www.rieti.go.jp/en/china/10102901.html

Figure 2.12: GDP Growth

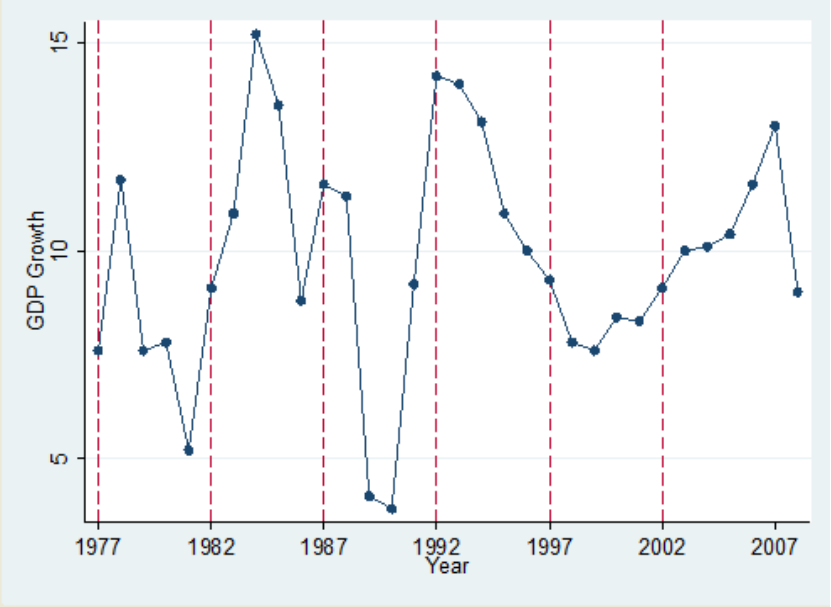
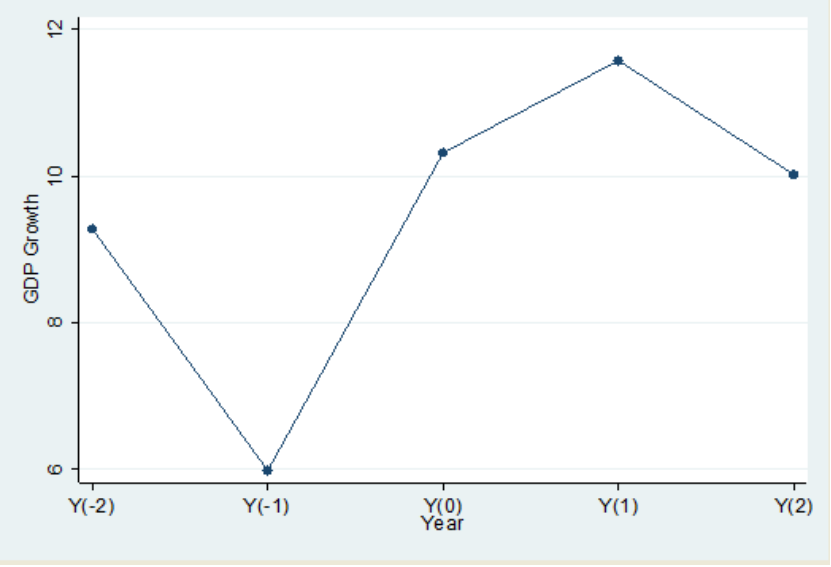


Figure 2.13: Average GDP Growth Rate around the Party Congress



discussed in the Central Economic Work Conference , which has regularly been held by the central government at the end of every year since 1994.[1] At this conference, the central leaders review the country's economic work in the past year, and map out economic plans for the coming year. "Political mobilization" has never been the theme of the Conference. There are two major differences between the studies of Hu and our study:

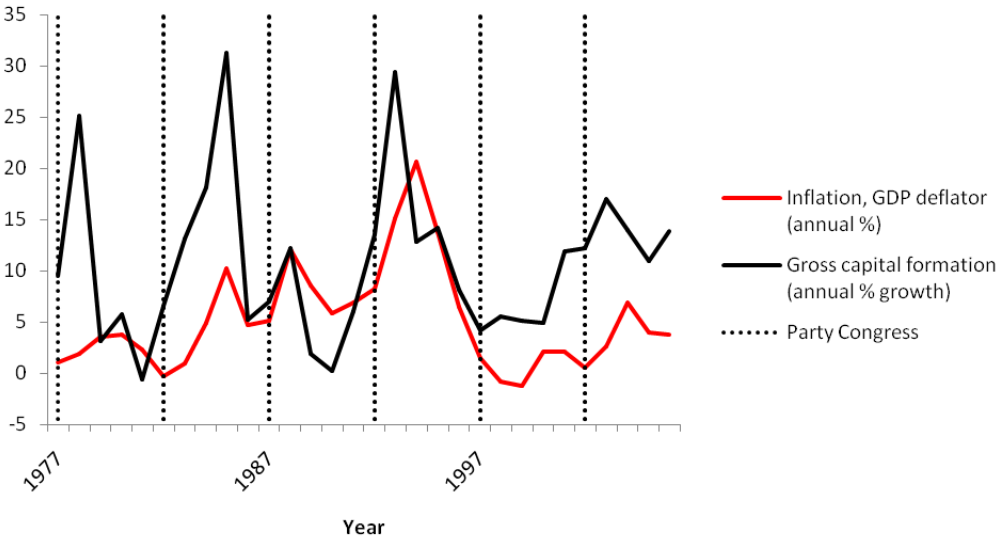
First, instead of GDP growth, we focus on capital formation growth, which has been the driving force of China's GDP growth and is more volatile. A clear picture emerges. Reexamining Figure 2.3, we can see that while the capital formation growth rate increases whenever the central government intervention has been completed, it is most likely to peak in the first year after the Congress when the new provincial leaders get power. As most interventions finish in the year before the Party Congress Years, capital formation growth (GDP growth) starts to increase in the Party Congress Year. This explains Hu's finding. But the dramatic increase in capital formation growth after each Party Congress year, which is the evidence motivating our study, is not obvious in the GDP growth rate. Therefore, focusing on GDP growth can be misleading as it seems to show that some pre-Congress factors are driving the increasing GDP growth rate in the Congress Year.

Second, we argue that following the decentralization reform, the problem of economic overheating is due to the provincial leaders rather than the central government. In Figure 2.14, we plot the time series of gross capital formation growth and the number of provinces with a change of the Provincial Party Secretary.

Besides the high correlation of the two series in the Party Congress Years, we can see that when the number of leader changes increases sharply in 1985, which is not a Party Congress Year, there is also a dramatic increase in the capital formation growth rate. The sequence of political events in 1982-1985 indeed provides a natural experiment to test the theories of Hu and ourselves.

[1] http://news.xinhuanet.com/ziliao/2005-12/01/content_3860628.htm

Figure 2.14: Number of Provinces with a Secretary Change and Gross Capital Formation Growth



In 1982, the central government announces the mandatory retirement rule on leader's age. This rule stipulates that a provincial leader who is not in the Political Bureau must retire at the age of 65. At that point in time, most Provincial Party Secretaries were older than 65. At the Congress in 1982, the old provincial leaders were not replaced by the central government, however. Most replacements took place in early 1985. At the end of 1985, a special Congress was held and the old provincial leaders formally resigned from the Central Committee. There was a moderate increase in the capital formation growth rate between 1982 and 1984, as the new rule affects the incentive of the old Provincial Party Secretaries. Once the young Provincial Party Secretaries get into power in 1985, there is a dramatic increase in growth and the central government intervenes in 1986. This is just as if there were a normal Congress held at the end of 1984 and growth increased dramatically after the Congress. This is a clear example showing that it is the provincial leader change at the Party Congress, not the Party Congress itself, that affects the timing of the business cycle.

More broadly, our paper is part of the extensive studies on the distortion of the agent's incentive arising from career concerns in principal-agent models. While the argument has initially been that the career concern serves as an implicit incentive, i.e. a substitute for the explicit incentive, for the agents to exert more effort (Fama 1980), later studies show that although career concerns may affect the agents' incentive in the right direction, the magnitude is wrong in general (see e.g. Holmström 1982; Narayanan 1985; Holmström and Ricart i Costa 1986; Scharfstein and Stein 1990; Zwiebel 1995; Prendergast and Stole 1996; Dewatripont, Jewitt, and Tirole 1999a,b). Consistent with the main result of this literature, our theory shows that too strong a career concern by the local leaders hurts the central government. Specifically, our model predicts that the short-run growth stimulus, inflation and the probability of central government intervention are all positively related to the size of the ego rent that is due to promotion. One normative implication of our theory is thus that reducing the size of the ego rent, i.e. basically the power and the privilege of leaders at all levels, is economically beneficial to the central government. For various political and other reasons that we will discuss in later sections, however, such a fine-tuning of incentives may be difficult to achieve.

2.7 Discussions

The fundamental cause of China's political business cycle after 1976 is political institutions. Like a Western democratic regime, the change of Chinese leaders is regular and institutionalized. Unlike a Western democratic regime, the appointment of China's leaders to a large extent depends on the central government. In the reform era, provincial leaders are evaluated according to their economic performance. This gives the provincial leaders a strong incentive to promote local growth and their behavior inflates the whole economy. Intervention by the central government reduces inflation and also

hurts output growth. The cycle is thus an inevitable outcome of the political institutions.

We conclude our study with a few discussions.

2.7.1 Broader Interpretation of S

In our paper, we focus on the local leaders' investment stimulus. More broadly, the S in our model can be explained as any effort of the local leaders to stimulate growth within their term. Such behavior may affect the composition of the investment project, i.e, the local leader has an incentive to choose the project with high short-run growth while disliking the project with low short-run growth but perhaps with a larger net present value. Such a current bias may also involve the abuse of power. For example, the local leader may kick out a farmer from his house and turn the land into a factory, which increases current growth. In this sense, corruption and growth are not mutually exclusive (see Lindbeck 2008 for a detailed analysis of this point). Another interesting issue is public debt, which can increase current growth at a future cost and generate a conflict of interest between successive local leaders. We leave these as future research topics.

2.7.2 China Model

There has been a growing interest in the China Model after the crisis. However, no study is clear about what actually is the China Model. Although our motivation in this paper is to study the mechanism of China's growth fluctuation, we have implicitly explored, at least from the political economist's perspective, the nature of the China Model, which can be summarized as follows:

1. Government directed economic growth.

2. Decentralization of economic power to the local government.

3. Political centralization of local leaders' evaluation and promotion.

4. Central government intervention when necessary.

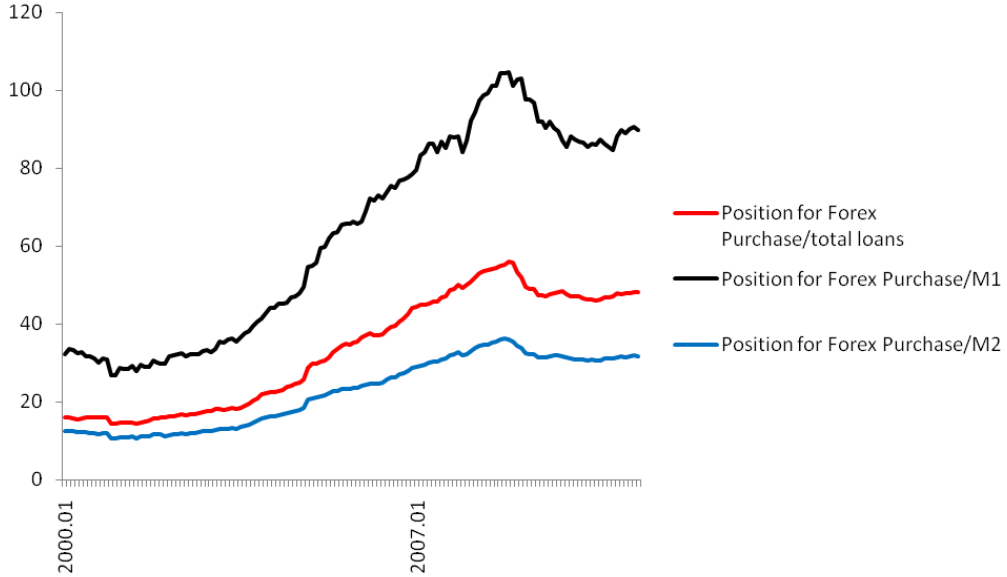
Many rules in China have changed since 1976. But the key characteristics of the above four points never changed and are very unlikely to change in the near future. They can be regarded as China's institutions after 1976. Among the four points, 3 and 4 are essential for the speed and sustainability of growth in the short run, both involving a high degree of centralization. In this sense, our study is in the spirit of Blanchard and Shleifer (2001) who point out that some degree of political centralization is essential for the success of decentralization. However, centralization creates rents for central leaders. This gives the local leaders the incentive to signal the competence valued by the central government, to get promoted. The political cycle is thus likely to be repeated in the future unless there is institutional change. If the degree of centralization cannot be reduced, we expect, based on our model, that any institutional change that can check and balance the power of local leaders can reduce the size of the cycle. Political modernization, which involves democracy and free media, may be a solution, although not necessarily the only one. Qian et al. (2011) indeed show that at the village level, the Chinese village leaders chosen through election carry out more pro-villager policies. Summing up, the China Model has important similarities with the Western Model and reforming in the Western direction actually makes the China Model work better.

2.7.3 The Future of Political Business Cycles in China

After China's entry into WTO in 2011, the Chinese economy is being increasingly integrated into the world economy and the inflationary pressure from the international dimension has been increasing. Specifically, the Chinese Central Bank has to purchase an increasing amount of foreign currency, which comes from trade surplus, foreign direct investment and the hot money

that expects the Chinese Yuan's to appreciate (see Figure 2.15 for the time series of the ratio of the Central Bank's position for the foreign exchange purchase over loans, M1 and M2).

Figure 2.15: International Inflationary Pressure



Such a purchase does not only lead to the accumulation of huge foreign reserves, but also to an increase in the money supply. This source of inflationary pressure is particularly important after July 2005 when the exchange rate of Yuan starts to float. In the year 2007, which is a Party Congress Year, the Chinese central government intervenes for the first time in a Party Congress Year. The growth rate was decreasing until late 2008 when the central government started to stimulate the economy, following the financial crisis. With this additional source of inflationary pressure from the international dimension, the timing of the investment growth peak is affected. The beginning of period 1 in our model does not coincide with the Party Congress and the time when the local leaders have the economic decision power. This is important for analyzing China's business cycle in the future.

We re-state our result with some caution: without external shocks, the peak year of China's capital formation growth most probably comes in the first year after the Central Party Congress year, where most top provincial leaders are replaced. Moreover, political cycles may spread to other dimensions used by the central government to evaluate the local leaders in the future.

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2.9 Appendix

2.9.1 Appendix I: Assumption 2

If the central government intervenes in both periods, total output in periods 1 and 2 is $2w$ and inflation will be zero in both periods. Moreover, as there is no signal about the competence of any local leader, the competence of any promoted local leader in the third period is the mean of competence $\bar{\theta}$. In this case, the aggregate utility of the central government in three periods is

$$W^I = 2aw + cm\bar{\theta}.$$

If the central government decentralizes the power in the first period and retains the right to intervene in the second period, the utility of the central government in three periods is

$$W = \left[a\left(\bar{\theta}+\bar{s}\right) - b\pi_1^2\right] + \Pr(I=1)aw + [1-\Pr(I=1)]\left[a\left(\bar{\theta}+\bar{s}\right) - b\pi_1^2\right] + c\int_0^m \theta_j dj.$$

where $\bar{s}$ is the mean of the distribution of equilibrium stimulus. Comparing W^I and W, the benefits of decentralization in the first period are as follows

(1) Higher expected output in the first two periods $\left(\bar{\theta}+\bar{s} > w\right)$, if the local leaders have a better knowledge of the local economy and more incentive to stimulate the local eoconomy than the central government.

(2) Higher expected competence of the promoted leaders in the third period. This is due to the fact that the central government can extract the signal of local leaders' competence from their output.

The cost of decentralization is first higher inflation in both periods.

Other things given, decentralization first dominates centralization in both periods when the intervention cost is high (low w), the disutility of inflation is low (low b) and the value of the promoted leaders' competence is high (high c). To make our analysis non-trivial, we focus on the set of parameters which ensures $W > W^I$.

2.9.2 Appendix II: Proof of Proposition 1

By the MLRP assumption, we have

$$\frac{f(y_1|\theta_1)}{f(y_1|\theta_2)} > \frac{f(y_2|\theta_1)}{f(y_2|\theta_2)} \tag{2.9}$$

Choose a θ^* for which $0 < G(\theta^*) < 1$. For $\theta_2 \leq \theta^*$, it follows from (2.9) that

$$\frac{\int_{\theta_1>\theta^*} f(y_1|\theta_1)dG(\theta_1)}{f(y_1|\theta_2)} > \frac{\int_{\theta_1>\theta^*} f(y_2|\theta_1)dG(\theta_1)}{f(y_2|\theta_2)} \tag{2.10}$$

(2.10) is equivalent to

$$\frac{f(y_1|\theta_2)}{\int_{\theta_1>\theta^*} f(y_1|\theta_1)dG(\theta_1)} < \frac{f(y_2|\theta_2)}{\int_{\theta_1>\theta^*} f(y_2|\theta_1)dG(\theta_1)} \tag{2.11}$$

Integrating (2.11) over θ_2 for $\theta_2 \leq \theta^*$ yields

$$\frac{\int_{\theta_2\leq\theta^*} f(y_1|\theta_2)dG(\theta_2)}{\int_{\theta_1>\theta^*} f(y_1|\theta_1)dG(\theta_1)} < \frac{\int_{\theta_2\leq\theta^*} f(y_2|\theta_2)dG(\theta_2)}{\int_{\theta_1>\theta^*} f(y_2|\theta_1)dG(\theta_1)} \tag{2.12}$$

By Bayesian rule,

$$f(y|\theta) = \frac{g(\theta|y)}{g(\theta)}$$

Apply Bayes' rule in (2.12),

$$\frac{\int_{\theta_2\leq\theta^*} \frac{g(\theta_2|y_1)}{g(\theta_2)}dG(\theta_2)}{\int_{\theta_1>\theta^*} \frac{g(\theta_1|y_1)}{g(\theta_1)}dG(\theta_1)} < \frac{\int_{\theta_2\leq\theta^*} \frac{g(\theta_2|y_2)}{g(\theta_2)}dG(\theta_2)}{\int_{\theta_1>\theta^*} \frac{g(\theta_1|y_2)}{g(\theta_1)}dG(\theta_1)} \tag{2.13}$$

Simplying (2.13), we get

$$\frac{\int_{\theta_2\leq\theta^*} g(\theta_2|y_1)dG(\theta_2)}{\int_{\theta_1>\theta^*} g(\theta_1|y_1)dG(\theta_1)} < \frac{\int_{\theta_2\leq\theta^*} g(\theta_2|y_2)dG(\theta_2)}{\int_{\theta_1>\theta^*} g(\theta_1|y_2)dG(\theta_1)} \tag{2.14}$$

(2.13) is equivalent to

$$\frac{G(\theta^*|y_1)}{1-G(\theta^*|y_1)} < \frac{G(\theta^*|y_2)}{1-G(\theta^*|y_2)},$$

which implies that

$$G(\theta^*|y_1) < G(\theta^*|y_2).$$

This means that the posterior distribution $G(\theta^*|y_1)$ dominates the posterior distribution $G(\theta^*|y_2)$ in the sense of strict first-order stochastic dominance.

By definition of first-order stochastic dominance,

$$\int U(\theta^*)\, dG(\theta^*|y_1) > \int U(\theta^*)\, dG(\theta^*|y_2)$$

for every increasing function U. Obviously, $U(\theta^*) = \theta^*$ is an increasing function and therefore

$$E(\theta^*|y_1) = \int \theta^* dG(\theta^*|y_1) > \int \theta^* dG(\theta^*|y_2) = E(\theta^*|y_2)$$

2.9.3 Appendix III: Estimated Results with Two-Way Clustered Errors

Table 2.5: Stimulus Cost and the Magnitude of the Cycle (Two Way Clustered Errors)

Dependent Variable	Real Capital Formation Growth			
	(1)	(2)	(3)	(4)
peakyear	0.073***	-0.043	-0.244***	-0.128*
	(0.029)	(0.026)	(0.094)	(0.070)
sc_output_ratio		-0.053		
		(0.039)		
sc_output_ratio*peakyear		0.167***		
		(0.059)		
sc_labor_ratio			0.077	
			(0.085)	
sc_labor_ratio*peakyear			0.345***	
			(0.124)	
sc_fai_ratio				-0.070*
				(0.088)
sc_fai_ratio*peakyear				0.280**
				(0.117)
Province fixed effect	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES
R-squared	0.217	0.248	0.241	0.237

Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level and at the year level.

* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

Table 2.6: Remaining Political Life and the Magnitude of the Cycle (Two Way Clustered Errors)

Dependent Variable	Real Capital Formation Growth			
	(1)	(2)	(3)	(4)
peakyear	0.059**	-0.061**	-0.281***	-0.162**
	(0.026)	(0.029)	(0.092)	(0.079)
rpl	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
rpl*peakyear	0.005	0.006*	0.006*	0.006
	(0.004)	(0.004)	(0.003)	(0.004)
sc_output_ratio		-0.055		
		(0.037)		
sc_output_ratio*peakyear		0.171**		
		(0.054)		
sc_labor_ratio			0.069	
			(0.087)	
sc_labor_ratio*peakyear			0.369***	
			(0.117)	
sc_fai_ratio				-0.073
				(0.088)
sc_fai_ratio*peakyear				0.305***
				(0.123)
Province fixed effect	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES
R-squared	0.226	0.260	0.253	0.250

Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level and at the year level.

* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

Table 2.7: Lame Duck and the Magnitude of the Cycle (Two Way Clustered Errors)

Dependent Variable	Real Capital Formation Growth			
	(1)	(2)	(3)	(4)
peakyear	0.049	-0.089**	-0.307***	-0.167*
	(0.034)	(0.044)	(0.111)	(0.089)
young	-0.02	-0.029	-0.022	-0.025
	(0.024)	(0.023)	(0.023)	(0.023)
young*peakyear	0.031	0.051*	0.049*	0.04
	(0.026)	(0.029)	(0.030)	(0.028)
sc_output_ratio		-0.066**		
		(0.035)		
sc_output_ratio*peakyear		0.178***		
		(0.061)		
sc_labor_ratio			0.068	
			(0.087)	
sc_labor_ratio*peakyear			0.373***	
			(0.131)	
sc_fai_ratio				-0.082
				(0.092)
sc_fai_ratio*peakyear				0.290**
				(0.124)
Province fixed effect	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES
R-squared	0.220	0.255	0.247	0.242

Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level and at the year level.

* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

Table 2.8: The Number of Central Seats and the Magnitude of the Cycle (Two Way Clustered Errors)

Dependent Variable	Real Capital Formation Growth							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
peakyear	-0.028	-1.002***	-0.783**	-1.026**	-0.980**	-0.906***	-1.144***	-1.092**
	(0.037)	(0.440)	(0.349)	(0.380)	(0.390)	(0.372)	(0.413)	(0.430)
RPL			-0.002	-0.002**	-0.002			
			(0.002)	(0.001)	(0.002)			
RPL*peakyear			0.0057*	0.0057*	0.0058**			
			(0.003)	(0.003)	(0.003)			
young						-0.032	-0.026	-0.029
						(0.024)	(0.024)	(0.025)
young*peakyear						0.059*	0.058*	0.054*
						(0.030)	(0.030)	(0.031)
sc_output_ratio			-0.05			-0.061*		
			(0.035)			(0.034)		
sc_output_ratio*peakyear			0.115**			0.117*		
			(0.056)			(0.061)		
sc_labor_ratio				0.084			0.084	
				(0.080)			(0.080)	
sc_labor_ratio*peakyear				0.221			0.218*	
				(0.142)			(0.152)	
sc_fai_ratio					-0.044			-0.052
					(0.085)			(0.087)
sc_fai_ratio*peakyear					0.191*			0.169
					(0.120)			(0.120)
number of seats*peakyear	0.009***	0.184**	0.134***	0.153***	0.156**	0.150**	0.168**	0.174**
	(0.003)	(0.081)	(0.065)	(0.074)	(0.073)	(0.068)	(0.079)	(0.080)
number of seats_square*peakyear		-0.007**	-0.006**	-0.006**	-0.006**	-0.006**	-0.007***	-0.007**
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Province fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
Term fixed effect	YES	YES	YES	YES	YES	YES	YES	YES
R-squared	0.226	0.255	0.274	0.273	0.272	0.267	0.271	0.269

Note: in parenthesis are standard errors which are robust to heteroskedasticity and adjusted for clustering at the province level and at the year level.

* indicates significance at the 10 percent level,** significance at the 5 percent level and *** significance at the 1 percent level.

Chapter 3

A Theory of Dynastic Cycle*

We have found a new way to avoid the cycle. That's democracy. The government will not shirk only when it is supervised by the people. The policies will not shift with the change of leaders only when everyone takes the responsibility of supervision.

–**Mao Zedong, 1945**

3.1 Introduction

Throughout China's History, the dynastic cycle, "characterized by peace and prosperity in the upswing when a new line of emperors is established, and by civil war, misery, and population decline in the downswing when the dynasty

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becomes old and feeble[1]", has been a recurring phenomenon. Yet there has been few theories that can explain the mechanism of the cycle. The Malthus view (e.g. Usher (1989)) could be an explanation. In an agricultural society, this view can be translated as follows: the growing population pressure on cultivated and cultivable land leads to a rural uprising which finally leads to the demise of the political regime. However, this is not supported by historical evidence. For example, according to Wang (1973), although various rural uprisings took place around 1850, the population only increased by 5 percent while cultivated land went up by over 25 percent between 1750 and 1850 in China. Perkins (1969) shows that only by the early twentieth century had China reached the point where there was no more new cultivable land and, even later, it reached the point at which traditional methods could no longer increase the per unit yields on land already under cultivation, while the rural uprisings had taken place long before that point. The climate view could also be an explanation. Zhang et al. (2008) find that the timing of bad weather, caused by summer monsoon, correlates well with the final decades of three of the five Dynasties of China, all times characterized by popular unrest. However, this finding cannot explain the collapse of all Chinese dynasties. Moreover, as pointed out by the authors, some prosperous periods in ancient China were accompanied by extremely bad weather. Therefore, the evidence shows that bad weather is not a sufficient condition for the collapse of a dynasty, but just acts as a negative economic shock in an agricultural society.

The failures of the Malthus view and the climate view indicate that there must exist some other mechanism that leads a dynasty to collapse more quickly than the pressure from population growth and that made it more vulnerable when facing negative economic shocks. What is it? This is the motivation for our paper.

In this paper, we propose a dynamic politico-economic theory on the Chinese dynastic cycle. At the heart of the theory is the Crown Prince problem

[1]This is defined by Usher (1989).

faced by an incumbent ruler. On the one hand, choosing a politically strong successor is economically beneficial since he will control the bureaucrats well and prevent bureaucratic corruption from becoming high. This encourages the current investment made by forward-looking citizens and thus increases the tax base of the incumbent ruler. On the other hand, a politically strong successor has a high probability of replacing the incumbent in the presence of the institutional weakness. We embed the incumbent ruler's trade-off between tax base and safety into an overlapping generation model and analyze the dynamics of the economy over time.

The model economy is populated by four kinds of two-period-lived overlapping generations of agents: the citizens, the incumbent ruler, the ruler's successor candidates and the bureaucrats. All citizens undertake a costly investment at birth and yield the returns in each living period. The incumbent ruler, who is in the set of successor candidates at birth, is designated as the successor in his first period of life by the previous ruler and is supposed to be the ruler in his second period of life. Once taking power, the ruler sets an age-independent tax rate before the young citizens make the investment decision to maximize the total tax revenue from young and old citizens. The intergenerational conflict between the incumbent ruler and his successor is played out as follows. The successor, by definition, is the person who will be the ruler after the death of the incumbent. For this reason, the successor always has an incentive to take the place of the incumbent in order to become the ruler earlier. Since the result of the power struggle between the incumbent and the successor is probabilistic, depending on their relative strengths, the stronger the successor, the less safe the incumbent will be.

However, the incumbent cannot simply choose the weakest successor, since the functioning of a dictatorial regime depends a great deal on the quality of the ruler.[1] No matter how strong a ruler is, he has to rely on

[1]Jones and Olken (2005) show that the effects of individual leaders on growth are strongest in autocracy. See also Fisman (2001) for an interesting study about the stock market reaction to rumors about the dictator's health.

some agents to implement his policies. This is modeled as the bureaucrats collecting the tax from the citizens for the ruler. The asymmetric information between the ruler and bureaucrats creates the possibility for corruption. Moreover, there cannot be any source of independent check and balance of the bureaucrats' power[1] since this means an erosion of the ruler's power. Due to the unbalanced power plus the asymmetric information between the ruler and the bureaucrats, corruption can hardly be eradicated.[2] In the model economy, bureaucratic corruption is modeled as the bureaucrats' surcharge of the citizens on top of the ruler's tax rate. That is, a bureaucrat can say that a citizen, who has actually paid the tax, has not paid; or a bureaucrat can say that a citizen, who has actually not paid the tax, has paid.[3] Since the bureaucrats' surcharge distorts the citizens' investment decision and decreases the tax base of the ruler, it is not in the interest of the ruler. The size of the bureaucrats' surcharge depends on the ruler's ability to regulate the bureaucrats, which is positively correlated with the ability to fight in the power struggle with the successor (incumbent), since these two abilities are both reflections of the leader's political skills.

Given the setup of the model, the incumbent ruler has a trade-off between his safety and the tax base. If the successor is too strong, the tax base is larger, as forward-looking young citizens make more investments because the bureaucrats' surcharge will be lower in the next period, but the incumbent will be in danger because he is more likely to be replaced by the successor when alive. We call this the *safety effect*. If the successor is too weak, then although the incumbent is safe, the tax base will be small, because forward-looking young citizens will make less investments as bureaucrats' surcharge will be higher in the next period. We call this second effect

[1]See Persson, Roland and Tabellini (1997) for the importance of separation, check and balance of power in democracy.

[2]See Shleifer and Vishny (1993), Svensson (2005) and Yi (2007) for a detailed discussion.

[3]See Acemoglu and Verdier (2000) for a microeconomic study **on** equilibrium surcharge.

the *tax base effect*. With two opposing effects, the incumbent will not tend to choose the strongest successor. Under the reasonable assumption that all incumbent rulers are primarily concerned about their own safety rather than the tax base, the strengths of the ruler will become lower and lower within one dictatorial dynasty.

There are two sources of dynamic inefficiencies in the model:

In the short run, as the incumbent sets the age-independent tax rate when the old citizens' investment is sunk, the tax rate set by the incumbent will increase with the size of the sunk investment. This will not only discourage the young citizens' investment, but also generate an oscillatory pattern on the equilibrium law of motion of the tax rate between generations. The intuition is as follows. If the last period tax rate is relatively high, then seen in the current period, the investment made by the old citizens will be relatively low. Facing such a situation, the incumbent will set a relatively low tax rate to encourage the young citizens' investment in order to increase the tax base. While if the tax rate is relatively low in the last period, then the investment made in the current period by the old citizens will be relatively high. Facing such a situation, the incumbent will set a relatively high tax rate to maximize the tax revenue, although this relatively high tax rate will reduce the young citizens' investment. This oscillatory pattern has two important implications: *(i)* Growth-enhancing economic reforms in a dictatorial regime can be reversed with the change of the ruler if there is no institutional reform that ensures the future ruler to commit to maintain the growth-enhancing policies. The reason is that, without institutional reform, the power to change the policies remains with the ruler, and as the tax base becomes larger due to the growth-enhancing economic reforms, the future ruler has an incentive to tax heavily on the sunk investment. The growth-enhancing economic reform can thus be reversed. This is in the spirit of Acemoglu and Robinson (2000); *(ii)* bureaucratic corruption and economic growth can be positively correlated in a dictatorial regime. If the tax base in the previous period is

low due to less sunk investment, the current ruler has an incentive to lower the tax rate, which is growth-enhancing, in order to increase the tax base. However, without the institutional change that checks and balances the power of the bureaucrats, the lower tax rate itself cannot put any constraint on bureaucratic corruption. On the other hand, a lower tax rate increases the tax base on which the bureaucrats can surcharge more. Thus, bureaucratic corruption and growth can be positively correlated.

In the long run, our model predicts that the fiscal revenue will shrink within one dynasty. The reason is the following. As rulers become weaker, the bureaucrats' surcharge becomes higher. That is, an increasing fraction of the tax base goes to bureaucrats. Moreover, increasing surcharges distort the citizens to make the investment which decreases the tax base. Combining these two effects, on the one hand, the citizens' burden is increasing and the possibility of uprising is also increasing. On the other hand, the tax revenue of the ruler becomes smaller. A fiscally feeble dynasty is vulnerable to uprising and any negative shocks. That is, the increasing corruption due to the degeneration of the rulers makes the dynasty more likely to have trouble and more vulnerable when there is trouble.

Combining the two sources of dynamic inefficiencies, we have the major conclusion of the model:

1. If there is a possibility of discontinuity of power due to the physical death of the ruler; and

2. If the ruler is primarily concerned with his own safety, rather than his tax base when choosing his successor; and

3. If the ruler has to rely on some agents whose power cannot be effectively balanced and checked; and

4. If the functioning of the dictatorial regime depends a great deal on the quality of the ruler; then

5. A dynastic cycle emerges and is repeated.

To the best of our knowledge, no previous work has analyzed how bureaucratic corruption caused by a deteriorating ruler's capacity leads to the demise of the dynasty. The two most closely related studies to our work are the following. The first is a paper by Gennaioli and Caselli (2005). In that paper, the authors show that due to the imperfections of contractual enforcement in developing countries, the ownership and the control of private firms often pass across generations within the same family. However, as it is impossible that there is always a member of the family with managerial talent, and that ownership and control are always transferred to the right person, family firms in developing countries will end up in the wrong hands sooner or later. Although the long run outcomes of family firms in Gennaioli and Caselli (2005) and the dictatorial regime in our paper are similar, the mechanism is different as there is an unnatural selection of the future ruler in our paper. Specifically, the incumbent ruler can choose a strong successor from a pool of candidates with all possible strengths. But the incumbent *intentionally* chooses a sufficiently weak successor as the future ruler due to safety concerns. The second is a book by Zelin (1984). In that book, the author argues that the Chinese dynasty collapses because the tax revenue ends up with the bureaucrats rather than the government. But the reason for this is not related to the quality of the ruler.

Methodologically, our paper is closest to that of Hassler et al. (2003)[1] which provides an analytical characterization of Markov Perfect Equilibria in a model with repeated voting. Like that paper, we focus on Markov Perfect Equilibria where the strategies of all agents are only conditioned on their

[1]Hassler et al. (2005, 2007) use similar structures to analyze democratic public good provision and the dynamics of a democratic government. Azzimonti Renzo (2007) and Song, Storesletten and Zilibotti (2007) also characterize the analytical solution to an MPE, but with a different microfoundation. Some other papers (Marco Bassetto, 1999, Krusell, Vincenzo Quadrini, and Rios-Rull, 1996; Krusell and Rios-Rull, 1996, 1999; and Gilles Saint Paul, 2001) embed a conflict of interest into repeated voting and yield numerical solutions.

pay-off-relevant state variables and characterize the analytical solution to the equilibria. However, our political game is different to the game in that paper because the politics is different in dictatorship. As pointed out by Acemoglu et al. (2004), "*The qualitative nature of politics appears to differ markedly between strongly and weakly-institutionalized polities: when institutions are strong, citizens punish politicians by voting them out of power; when institutions are weak, politicians punish citizens who fail to support them. When institutions are strong, politicians vie for the support and endorsement of interest groups; when institutions are weak, politicians create and control interest groups. When institutions are strong, citizens demand rights; when institutions are weak, citizens beg for favors.*" In our model, the policy is made by a selfish ruler, rather than reflecting the preference of the decisive voters; the leadership turnover depends on the relative strengths between the incumbent ruler and his successor, rather than via democratic voting; the economic policies are implemented in a costly way by selfish bureaucrats whose power is not balanced and checked, rather than through an efficient and costless bureaucratic system. We believe that these changes in the political game capture the main difference between the politics of democracy and dictatorship.

In addition to providing a theory on the Chinese dynastic cycle, our paper also contributes to the economic literature on the internal organization of dictatorship. This small and growing literature can be divided into two strands. From a microperspective, Egorov and Sonin (2006) formalize the loyalty and competence trade-off faced by the dictator when choosing agents and explore the incentive for a dictator to keep incompetent agents; Acemoglu, Egorov and Sonin (2008) show that the size of ruling coalitions is determined by a trade-off between "power" and "self-enforcement". Ruling coalitions must not only be powerful enough to be able to impose their wishes on the rest of society, but also self-enforcing so that none of their subcoalitions is sufficiently powerful to wish to split from or eliminate the rest of this

coalition. Egorov and Sonin (2005) explore the trade-off faced by a winner of the throne after the power struggle. If the winner kills the loser, the threat of power is reduced. But the winner builds up a tough reputation and will probably be killed by his contender when losing the power struggle in the future. While if the winner spares the loser, the loss is that the loser may compete for power again and the gain is the slighter punishment when losing in a future struggle. From a macro perspective, Acemoglu, Robinson and Verdier (2004) argue that the survival of a dictator depends a great deal on his ability to implement the "Divide and Rule" strategy among his subordinates. Debs (2007,2008) shows that growth is positively related to a dictator's strength as more able dictators can control more able agents, who are more productive. Padro-i-Miquel (2007) shows that a successful dictator cannot only expropriate the citizens outside the ruling group but also his supporters inside the ruling group while still keeping the support of his supporters because once the leader is replaced due to the loss of support from his supporters, there is a chance that the citizens outside the ruling group can get the power and the core supporters of the current dictator will become expropriated. Besley and Kudamatsu (2007) show that an autocratic government works well when the power of the selectorate does not depend on an incumbent leader. Our paper extends the existing literature in two important ways. First, we do not only focus on the conflict of interest between the incumbent ruler and his agents, but also on the intergenerational conflict between the current ruler and the future ruler. Second, we embed the latter conflict of interest into an overlapping generations model to derive the macroeconomic implications of this conflict on the dynamics of dictatorship.

The paper is organized as follows. Section 2 provides some case studies. Section 3 describes the model environment. Section 4 defines and solves analytically the Markov Perfect Political Equilibrium. Section 5 concludes the paper. All proofs are in the appendix.

3.2 Case Studies

In this section, we present some historical evidence that supports our theory. We note that in the historical literature, some works about palace politics focus on the conflict of interest between the current ruler and the future ruler, but not on the implications of this conflict on bureaucratic corruption; some other works focus on the interaction between bureaucrats and citizens and point out that it is the decay of the ruler's power that leads to an increase of bureaucratic corruption and thus of the burden on the citizens, which leads to the final demise of a dictatorial government, although these works do not explain the reason for the decay of the ruler's power. In the two following subsections, I provide historical evidence from the Qing Dynasty, the last imperial dynasty of ancient China, from the above two perspectives.

3.2.1 The Conflict of Interest between Successive Rulers[1]

Emperor Kangxi (1654-1722) is regarded as the founder of the Qing Dynasty (1644-1911), because he united China after conquering Mongolia, Taiwan, and Tibet, getting rid of the warlords' threats from three provinces in southern China and defeating the Tzar's Russia, although there were three other emperors before him in this dynasty. In the year of 1676, Kangxi's designated his second surviving son Yinreng, at the age of two, as the Crown Prince of the Great Qing Empire.

Even though Kangxi favored Yinreng and had always wanted the best for him, Yinreng did not prove to be cooperative. Yinreng's supporters, led by Suoertu, gradually formed a "Crown Prince Clique", which tried its best to make Yinreng the emperor as soon as possible, using any possible method. Emperor Kangxi was perfectly aware of Yinreng's misbehavior. The relation-

[1]This subsection has been adapted from the introduction of Kangxi, Yongzheng and Qianlong in Wikipedia and Feng (1985).

ship between the father and the son gradually deteriorated. In the 46th year of Kangxi's reign (1707), Kangxi decided that "after twenty years, he could take no more of Yinreng's actions", which he partly described in the Imperial Edict as "too embarrassing to be spoken of", and decided to demote Yinreng from his position as Crown Prince. Yinzhi, Kangxi's eldest surviving son, who had many times attempted to sabotage Yinreng, even employing witchcraft, was appointed to watch Yinreng during his home arrest. With such an important task, Yinzhi thought he had the trust of Kangxi and would be made the new Crown Prince. To ensure his position as Crown Prince, Yinzhi even asked Kangxi for permission to execute Yinreng. This enraged Kangxi and Yinzhi was immediately arrested and kept under home arrest till his death.

With a vacant position as Crown Prince, a debate began among officials and members of the royal family. Everyday, rather than working, everyone in the central government and the palace just speculated who might be the new Crown Prince and spread various rumors, although Emperor Kangxi advised the officials and the nobles to stop such a debate. The 8th Prince, Yinsi, who was widely known as the "wise prince", turned out to get most support from the officials. However, Kangxi did not favor Yinsi because the emperor was aware of Yinsi's strength and was afraid of an abnormal death caused by Yinsi once having chosen him. Facing such a situation, Kangxi re-established Yinreng as the Crown Prince as a temporary solution to avoid a malfunctioning of the government and, more importantly, to prevent Yinsi from being chosen as the Crown Prince. The official reason for the reestablishment was that Yinreng's former fault was the result of mental illness caused by Yinzhi's (the first Prince) witchcraft and Yingreng should need some time to recover.

However, Yinreng did not "recover" at all. In 1712, during Kangxi's visit to Southern China, Yinreng ruled as the regent in charge of the routine affairs of the central government in Beijing. With more power than before, Yinreng decided to mount a coup against Emperor Kangxi. This coup was unsuccessful because Emperor Kangxi had received the information from

several sources in advance. When Kangxi returned to Beijing, he removed Yinreng from the position as Crown Prince for the second time. Yingreng was then kept under home arrest until his death.

Emperor Kangxi's health was badly affected by the Crown Prince problem. To prevent any further debate on this issue, Kangxi officially declared that he would not designate a Crown Prince until his death. Thus, he would put his political testament concerning Crown Prince inside a box, which could only be opened after his death, in one palace of the Forbidden City.

However, Kangxi's choice of Crown Prince through the secret arrangement was not unpredictable. After the removal of Yingreng, Kangxi carried out a political purge. Yinxiang (the 13th Prince), the supporter of Yinzhen (the 4th Prince) was placed under home arrest for "cooperating with Yinreng". Yinsi (the 8th Prince) was declared not to be eligible for the position as Crown Prince due to his guile and his mother's humble origins. The 14th Imperial Prince Yinti, who many considered to have the best chance for succession, was sent to quell rebels in Western China far away from Beijing. It turned out that Yinzhen, the 4th Prince, was the only adult prince with the chance of being chosen as Crown prince to survive the purge and the purpose of Emperor Kangxi's purge was to pave the way for Yinzhen to get the crown.

On December 20, 1722, Emperor Kangxi died after ruling China for 61 years and Yinzhen became the new emperor. Historians previously believed that Yinzhen forged Kangxi's testament and killed the old emperor. According to some new evidence,[1] the current consensus among historians is that Kangxi designated Yinzhen as the successor. But Kangxi's death still remains a myth among historians. Yinzhen's strategy to get the crown was noteworthy. Fully aware of the fact that the Crown Prince must face the threats from all other princes and the suspicion of the old emperor, Yinzhen worked hard for Emperor Kangxi, showing intentionally that he had no interest in

[1]Emperor Kangxi's testament, which was written in three different languages, was recently publicly displayed in the Forbidden City.

striving for power although the fact was the totally opposite, and tried to keep a good relationship with all princes. With the strategy of neutralism, Yinzhen became the sole beneficiary of the conflict among the other princes and Emperor Kangxi.

The power struggle for the throne did not stop with Emperor Kangxi's death. Upon getting the throne, Yinzhen released his long-time ally, the 13th prince Yinxiang, who had been kept under home arrest because his old father was afraid that Yinxiang's striving for power for Yinzhen would cause trouble that could obstruct the plan to transfer the power to Yinzhen. With the help of Yinxiang, the new emperor, Yinzhen, continued to keep Yinzhi (the 1st Prince) and Yinreng (the former Crown Prince) under home arrest. Yinti (the 14th Prince) was placed under home arrest at the Imperial Tombs after returning to Beijing from the west for Kangxi's funeral, under the pretext of watching over Kangxi's tomb. The biggest challenge for the new emperor was to destroy Yinsi's (the 8th Prince) clique, which mainly consisted of Yinsi himself, the 9th Prince, the 10th Prince, and their many subordinates in the government. Yinzhen did this step by step. First, Yinsi was nominated Prime Minister. By doing this, Yinzhen could keep close watch over Yinsi himself. Second, the 9th Prince was sent to West China under the control of Yinzhen's trusted general, at the pretext of supervising the army. Third, the 10th Prince was deprived of all his titles and sent outside Beijing. Both princes died soon after leaving Beijing. Finally, Yinsi was deprived of all titles and died all alone.

With the end of the old struggle for the position of Crown Prince among Yinzhen and his brothers, the new struggle for Crown Prince started between two of the three Yinzhen living sons, although Yinzhen used the same secret method to designate his successor as his father. The conflict was between the fourth Prince, Hongli, who was favored by Emperor Kangxi and Yinzhen, and was also believed by the officials to be the successor, and the third Prince, Hongshi, who was supported by his eighth Uncle, Yinsi. Hongshi lost the

power struggle against Hongli and Yinzhen, and was forced by his father to commit suicide in 1727 at the age of 24.

In 1735, Yinzhen died suddenly at the age of 57 and Hongli came into power at the age of 24. The reason for Yinzhen's death was believed by historians to either be the result of too much hard work or the irregular use of medicine produced by Taoists. There was no documented conflict between Yinzhen and Hongli.

In 1796, after ruling China for 61 years, Hongli transferred the power to his son, Emperor Jiaqing, while still being alive in order not to rule longer than his grandfather, Emperor Kangxi. However, Hongli changed his mind soon after the power transfer. He named himself Supreme Emperor and kept a tough control of everything till his death in 1799.

From the above evidence about power transfer in dictatorship, it is clear that (i) the incumbent ruler is primarily concerned about his own safety and thus (ii) the successor may not necessarily be the strongest among all candidates.

3.2.2 The decay of ruling elites, the rise of land tax and the fall of dynasties[1]

The record of the Qing dynasty, beginning with the redistribution of land and the lightening of taxes and ending with the degeneration of the ruling class, the swollen accumulation of estates in the hands of private, privileged, tax-evading landholders, extortionate taxation of the poor peasantry, and helplessness in the face of foreign invasion, is an epitome of Chinese economic and social history.

In the late years of the Ming Dynasty (1368-1644), excessive taxation and corruption in the levying of taxes provoked peasant uprisings all over China. The Manchus conquered China and set up the Qing Dynasty by taking

[1]This subsection has been adapted from Wang (1936).

advantage of the collapse of the Central government of Ming caused by the rebelling peasant army, which actually conquered the capital of the country and caused the suicide of the last emperor of the Ming Dynasty. The new Manchu rulers redistributed land to the peasants and reduced the land tax rate. The reward for these efforts was the social stability in the earlier period of Manchus' rule. Hoping to restore such stability forever, the emperor of Kangxi set the "permanent settlement" decree in 1713, which entails a commitment that the tax burden will never be increased.

The good intentions of Kangxi did not lead to any good outcomes. Like in any other dynasty, the Manchus, or the ruling elites, became a privileged class in society and no imperial decrees could stop their exploitation of the rest of society. Members of the ruling elites gradually robbed the central government of wealth and power. They could not possibly be restrained; although their job is to protect the interests of the nation, they are also private individuals who are the sole beneficiaries of corruption. While some of them, as officials, understood what was wrong, the most that they could accomplish as a class was to try to protect both the government interest and their class interest by trying to make up for the taxes which they themselves evaded by increased taxation of the poor and unprivileged class. The whole process may briefly be summarized in the following paragraph:

Since land was the basic source of wealth, the interest of the central government was to obtain the greatest possible volume of land tax. But since the interest of the privileged class (including the landlords who had connections with the privileged class) was to extract rent and evade taxation of their own lands, the volume of land tax revenue could only be kept up by an increased rate of levy on the peasants. The burden of the peasants became even heavier as local governors can surcharge the land tax and pocket this surcharged income due to the general slackness in the administration caused by the decay of the central government's political power. By and by, peasants started to sell their land to the privileged class and became its tenants. This

further increased the burden on the remaining peasants. The disproportionate concentration of land to the privileged class increased its power. The more powerful they became, the less they paid, and the less they paid, the more insistent became the pressure on the decreasing number of small peasant proprietors. By the end of the dynasty, the original strong centralized power of the Manchus had broken down into a system of arbitrary and suicidal exploitation by the whole ruling class, for the individual and competitive benefit of the separate members of the class. As a result, the Qing dynasty fell with the peasant insurrections and the invasion of Western colonists.

The following three examples document the extent of the corruption at different levels in the late Qing Dynasty and a comparison of the extent of corruption at different points in time in the dynasty.

1. **Corruption at low levels**. When the date for the collection of land tax had been proclaimed, the petty officials and their hangers-on went to each village, forced their way into the cottages of the peasants, and compelled them to an make immediate payment of the tax. If there were any delay, the peasants would be lashed till their blood spurted, unless they paid, as a bribe, what was known as pao-erh-ch'ien or "pocket money," in earnest of full payment later. Payments of this kind might have had to be made more than once, and might even, in the end, have amounted to more than the total tax due. But as they were not discounted against the tax, the full amount still remained to be paid. Peasants who had enough grain to pay their tribute promptly brought it to the Yamen (local government), the whole family of each peasant attending, including the women. They actually had to appear before the due date, so that there would be no delay on the day of payment. If it rained while they were waiting, they had to protect their rice as best they could, for fear that the dampness would make the color change. Even if the collectors received it on time, various demands for "wastage charge", "light weight charge," "cargo charge," "transport charge" and

so forth might still have to be met, so that it was not regarded as abnormal for a peasant to pay his tax at the rate of 250 per cent of the assessed amount. When the collectors measured the grain, they usually managed to get a considerable surplus (to later be deducted privately for their own benefit), by "trampling the measure," in order to pack it tight, and by heaping a cone on top of it so that, in the biblical phrase, it should be "pressed down and running over." When this had been done, even the spare grain that the peasant had brought to meet the surcharges was likely not to be enough. If the grain was measured with a discount of 30 percent (a frequent practice), the storage would be all the greater. Disputes between taxpayers and tax collectors were therefore common, which gave the collectors a further opportunity to extort hush-money, on the grounds that the peasant had refused to pay.

2. **Corruption at high levels.** In the transport of the grain tribute to Bejing, the Provincial Grain Intendant demands his ts'ao-kuei (grain fee, grain perquisite); the Grain Commissioner (equal in rank to a viceroy, and charged with the transport and disposal of tribute grain from the eight provinces adjacent to the Yangze, to be shipped to Bejing by the Grand Canal) demands it; even the Deputy Prefects and Magistrates – all demand it. The office of the Prefect demands a lodging fee; the office of the Provincial Treasurer demands a lodging fee; the petty officers of the Grain Commissioner – they all demand it.

3. **The change in the extent of corruption.** In the past, when the collection of land tax began, the local officials used to send several strong men to guard the official grain measure. Now, however, they openly declare a discount of 20 percent (in measuring the grain); on top of this another 20 percent is demanded. Besides heaping up the surface of the measure, trampling it down, and "seizing the pig[1]", they demand food-

[1] "Seizing the pig" refers to the "squealing" of the peasant when seized by the tax

> money and a transport fee, a tax-roll fee, a fee for stamping the seal, a fee for sifting rice, a granary door fee, and a granary fee, amounting in all to two tou (20 percent on the shih, the unit of measurement). The taxpayer has to pay more than 2.5 shih for each shih.

The evidence is convincing enough to show that toward the end of the Qing Dynasty, the total taxation centering around the land tax had swollen to the almost incredible proportion of 20 to 30 times of the "permanent and unalterable" tax determined at the beginning of the dynasty, and the conditions which had caused the fall of the Ming dynasty had been reproduced. Therefore, the people, growing full of hatred, rose and rebeled. Sporadic insurrections began in the reign of Tao Kuang(1821-1850), the most serious of them being in Hunan 1844 and, at the same time, there were scattered risings in Chekiang, where the slogan of the peasants was a refusal to pay the land tax, as it had been at the end of the Ming dynasty two centuries before. The great Taiping Rebellion began in 1851, in Kuangsi, and had occupied two thirds of the country before its defeat in 1865. The rebellion of the Nien Min began in 1853, starting in Shantung and spreading widely through the north, where it dragged on for years; in 1871 there was another general rising in Shantung against the collection of the land tax. Therefore, the Boxer Rising of 1900 stemmed from what was by then an established tradition of peasant revolts, and there is no doubt that the Boxers were mainly recruited from poor peasants who had originally rebelled against payment of the land tax. In the end, the Qing Dynasty fell for the same reason as the Ming Dynasty and the whole country was divided by several warlords.

3.3 The Model

The model economy has a two-period OLG structure and, in every period, there are four types of risk neutral agents: the citizens, the ruler, the ruler's

collectors to force him to pay up.

successor candidates and the bureaucrats. The mass of each generation of citizens is unitary. Each of the citizens undertakes an investment when born, which costs $\frac{i^2}{2}$, and yields a return i in both periods of life. The ruler sets an age-independent tax rate to maximize the tax revenue from the investment returns of the young and the old citizens.

No matter how strong is a ruler, he must face the two following problems regarding the power: *(i)* The discontinuity of power caused by the physical death of the ruler; and *(ii)* the delegation of power.

The ruler has a dilemma when solving the first problem. If the ruler does not designate anyone to be his successor when alive, there will be some chaos, where δ of the citizens' investment will be destroyed, caused by the power struggle for the crown after the death of the ruler. Such a bad state ex post will decrease the citizens' investment ex ante and decrease the ruler's tax base. Alternatively, the ruler can designate his successor when alive. Although this can preclude the possibility of chaos after the dictator's death and increase the ruler's tax base, such a method reduces the ruler's safety when alive, since the successor always has an incentive to take the place of the incumbent as early as possible. Following the result of the political science literature,[1] I assume that $\delta = 1$, such that designating the successor when alive always dominates leaving no successor after death.

Assume that some successor candidates with mass m ($m < 1$) are born in every period. These candidates are the only group of people in the economy that have the privilege that they might be the future ruler. Every incumbent ruler designates his successor from one of the successor candidates at the beginning of the incumbent's second period of life and transfers the power to the successor before his death. Unless there is a coup, the timing of the power transfer should be as follows: at the beginning of any period t, the incumbent ruler, who is in his second period of life and was designated as successor by

[1]Herz (1952) provides a detailed discussion about this problem and shows that designating a successor when alive dominates any other method.

the previous ruler in period $t-1$, becomes the ruler and meanwhile designates the successor from the successor candidates born in period t; at the end of period t, the incumbent ruler transfers the power to the successor. If there is a coup, the new designated successor replaces the incumbent ruler in period t and will keep the power for two periods.

The strength of the successor candidate has a uniform distribution in $[0, m]$, such that a candidate j can be marked by his strength $\alpha_j \in [0, m]$. The probability of the incumbent ruler α_i, who was among the successor candidates in the previous period and thus can also be marked by his strength α_i, to win the power struggle with his successor candidate α_j is

$$P(\alpha_i \text{ wins}) = \begin{cases} 1 & \text{if} \quad \frac{\alpha_i - \alpha_j}{\alpha_i} \geq d \\ \frac{1}{2}, & \text{if} \quad -d \leq \frac{\alpha_i - \alpha_j}{\alpha_i} < d \\ 0, & \text{if} \quad \frac{\alpha_j - \alpha_i}{\alpha_i} > d \end{cases}$$

The intuition of conflict technology is that if the incumbent is sufficiently stronger than the successor, the incumbent will win with certainty; if the difference between the ruler's strength and the successor's strength is not sufficiently large, the probability that each side wins is one half; if the incumbent is sufficiently weaker than the successor, the incumbent will lose with certainty. d is a measure of incumbent advantage in a power struggle, where the larger the size of d, the lower the incumbent advantage.

As we have mentioned, in addition to the problem of power transfer, the ruler also has to delegate his power to the bureaucrats. Due to the nature of dictatorship, there cannot be any source of independent check and balance of the bureaucrats' power since this means an erosion of the ruler's power.[1] Moreover, the asymmetric information between the ruler and bureaucrats creates the opportunities for corruption. The unbalanced power plus the asymmetric information between the ruler and the bureaucrats make corruption hard to eradicate in dictatorship. In the model economy, bureaucratic

[1]See Yi (2007) for a detailed discussion.

corruption is reflected as the surcharge of tax by the bureaucrats to the citizens on top of that tax rate set by the ruler. That is, a bureaucrat can say that a citizen, who has actually paid the tax, has not paid; or a bureaucrat can say that a citizen, who actually has not paid the tax, has paid. In equilibrium, the bureaucrats can charge more than the tax rate announced by the ruler. Since the bureaucrats' surcharge distorts the citizens' investment decision and decreases the tax base of the ruler,[1] it is not in the interest of the ruler. The size of the surcharge depends on the strength of the ruler in regulating the bureaucrats.[2] The ability for an incumbent (successor) to fight in the power struggle with a successor (incumbent) and the ability to regulate the bureaucrats are correlated, as these two abilities both reflect the leader's political skills. Technically, I assume that if the tax rate set by the period t ruler α_t^d is τ_t^d ex ante, the bureaucrats can surcharge $(n - \alpha_i)$ ex post on the citizens without any risk. For given τ_t^d and α_t^d, this means that the real tax rate τ_t^r that the citizens face ex post is

$$\tau_t^r = \tau_t^d + n - \alpha_t^d$$

with $n \geq m$.

3.4 Political Equilibrium

The purpose of this paper is to explore the impact of a conflict of interest between the incumbent ruler and his successor on the strength of rulers generation after generation, which affects the extent of bureaucratic corruption over time and the evolution of the regime. More specifically, can a regime

[1] Mauro (1995) shows that corruption is negatively related to growth and investment, and corruption affects growth through investment. See also Fisman and Svensson (2007) for a study of corruption and growth at the firm level.

[2] Feng (1985, p153) documented the dramatic decrease in bureaucrats' surcharge soon after a strong rulerr took power in China. In some provinces, for example Henan and Shandong, the surcharge rate went down from 80% to 13% and 18%, respectively.

with a continuous conflict of interest between the current and the future ruler, which affects the distortion on investment caused by bureaucratic corruption, be sustainable in the long run? In order to answer this question, I start to solve an equilibrium without the crown prince problem as a benchmark. This can help characterize the equilibrium with the crown prince problem.

3.4.1 Equilibrium without Crown Prince problem

In this case, I assume that the successor's moral concerns always dominate his economic concerns. That is, the successor never tries to get the power one period earlier from the incumbent ruler. The timing of the game is as following:

1. At the beginning of period t, the old incumbent ruler chooses his successor, who gets the power at the end of period t when the incumbent dies;

2. The successor candidates other than the one chosen by the incumbent as the successor are eradicated;

3. The incumbent sets the tax rate τ_t^d;

4. The young citizens born in period t make their investment i_t;

5. The bureaucrats surcharge and collect the tax for the old incumbent;

6. The incumbent transfers his power to the successor at the end of period t.

Given the assumption about the game, the indirect utility functions of the living agents are as follows

$$V^{oc} = (1 - \tau_t^r)\, i_{t-1}$$

$$V^{yc} = (1-\tau_t^r)\, i_t + \beta\left(1-\tau_{t+1}^r\right) i_t - \frac{i_t^2}{2} \tag{3.1}$$
$$V^{od} = \tau_t^d\left(i_{t-1}+i_t\right)$$

where V^{oc}, V^{yc}, V^{od} denote the objective of the old citizen, the young citizen, and the incumbent old ruler, respectively. τ_t^d, τ_t^r, α_t^d, i_t denote the tax rate imposed by the ruler, the real tax rate faced by the citizens, the strength of the incumbent ruler and the investment made by a young citizen in period t, respectively. Note that we have skipped the indirect utility function of the bureaucrats as it is straightforward to see that they will surcharge as much as possible. Moreover, we have assumed that the only source of the bureaucrats' income is corruption and the ruler does not need to pay the bureaucrats any wage. Simple maximization in (3.1) shows that the solution to the optimal investment problem of the young citizen, given the real tax rates in his two periods of life, τ_t^r and τ_{t+1}^r, is

$$i_t^* = (1-\tau_t^r) + \beta\left(1-\tau_{t+1}^r\right) \tag{3.2}$$

Definition 1. *A (Markov Perfect) Political Equilibrium is defined as a triplet of functions* $\langle A, T, I\rangle$ *where* $A : [0,m]\times[0,1-\beta] \to [0,m]$ *is the ruler's decision rule on the strength of his successor,* $a_{t+1}^d = A\left(a_t^d, i_{t-1}\right)$, $T : [0,m]\times[0,1+\beta] \to \left[0, 1-n+a_t^d\right]$ *is the ruler's policy decision rule on the tax rate,* $\tau_t^d = T\left(a_t^d, i_{t-1}\right)$ *and* $I : [0,m]\times[0,1] \to [0,1+\beta]$ *is the young citizens' private investment decision rule* $i_t = I\left(\alpha_{t+1}^d, \tau_t^r\right)$, *such that the following functional equations hold:*

1. $\left\{A\left(a_t^d, i_{t-1}\right), T\left(a_t^d, i_{t-1}\right)\right\} = \arg\max_{a_{t+1}^d, \tau_t^d} V^{od}\left(\tau_t^d, \tau_{t+1}^d, \alpha_{t+1}^d, \alpha_t^d, i_{t-1}\right)$ *subject to* $\tau_{t+1}^d = T\left(A\left(a_t^d, i_{t-1}\right), I\left(\alpha_{t+1}^d, \tau_t^r\right)\right)$.

2. $I\left(\alpha_{t+1}^d, \tau_t^r\right) = 1-\tau_t^r+\beta\left(1-\left(T\left(a_{t+1}^d, I\left(\alpha_{t+1}^d, \tau_t^d+n-a_t^d\right)\right)+n-\alpha_{t+1}^d\right)\right)$

3. $V^{od}\left(\tau_t^d, \tau_{t+1}^d, \alpha_{t+1}^d, \alpha_t^d, i_{t-1}\right) = \tau_t^d\left(i_{t-1}+I\left(\alpha_{t+1}^d, \tau_t^r\right)\right)$.

According to Definition 1, the state of the model economy in period t is captured by two state variables, a_t^d and i_{t-1}. The first equilibrium condi-

tion requires that the incumbent old ruler chooses $a_{t+1}^d$and τ_t^d to maximize his indirect utility function, taking into account that the future ruler's decisions about the tax rate and the successor's strength depend on the current ruler's choice via the equilibrium decision rules. Furthermore, it requires that $A\left(a_t^d, i_{t-1}\right)$ and $T\left(a_t^d, i_{t-1}\right)$ are both fixed points in the functional equation in part 1 of the definition. The second equilibrium condition implies that all young citizens choose their investment optimally, given a_t^d and τ_t^r, and that the young citizens hold rational expectations about how the future tax rate and the ruler's strength are determined. The third equilibrium condition means that the old incumbent does not need to worry about his safety since, by assumption, the successor never tries to seize the power one period earlier. The constraint that $\tau_t^d \in \left[0, 1-n+a_t^d\right]$ is equivalent to $\tau_t^r \in [0,1]$, which means that the real tax rate that the citizens face cannot be larger than one as there is no saving in the economy.

Proposition 1. *If $m \leq n \leq 1-\frac{1}{2}m\beta$, in the equilibrium without the crown prince problem, $\langle A, T, I\rangle$ is characterized as follows:*

$$A\left(a_t^d, i_{t-1}\right) = m$$

$$T\left(a_t^d, i_{t-1}\right) = \begin{cases} \frac{1}{2-\beta} i_{t-1} + \frac{1}{2}a_t^d + \frac{\frac{\beta m}{2}+1+\beta-n-n\beta}{2+\beta}, & if \quad i_{t-1} \in [0, \bar{i}_{t-1}] \\ 1+n-a_t^d, & if \quad i_{t-1} \in (\bar{i}_{t-1}, 1+\beta] \end{cases}$$

$$I\left(\alpha_{t+1}^d, \tau_t^a\right) = \begin{cases} 1-\tau_t^r, & if \quad \tau_t^r \in [0, \bar{\tau}_t^r] \\ -\frac{(2-\beta)\tau_t^a}{2} + \frac{\beta}{4}a_{t+1}^d + \frac{(2-\beta)\left(4\beta-2n\beta-m\beta^2+4\right)}{4(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}_t^r, 1] \end{cases}$$

for given a_0^d and all t, where

$$\bar{i}_t \equiv \frac{2-\beta}{\beta+2}\left(1-n-\frac{1}{2}m\beta + a_{t+1}^d + \frac{1}{2}\beta a_{t+1}^d\right)$$

and

$$\bar{\tau}_t^r \equiv \frac{(\beta-2)\,\alpha_{t+1}^d}{(2+\beta\,(1-d))} + \frac{1}{\beta+2}\,(2n+2\beta-n\beta)$$

Furthermore,

(1) With any $a_0^d \in [0,m]$ and $i_{-1} \in [0,1+\beta]$, $\langle A,T,I\rangle$ converges to the following equilibrium in one period with

$$A\left(a_t^d, i_{t-1}\right) = m$$

$$T\left(a_t^d, i_{t-1}\right) = \begin{cases} \frac{1}{2-\beta} i_{t-1} + \frac{\beta+1}{\beta+2}\,(m-n+1)\,, & if \quad i_{t-1} \in [0,\bar{\imath}] \\ 1+n-m, & if \quad i_{t-1} \in (\bar{\imath}, 1+\beta] \end{cases}$$

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = \begin{cases} 1-\tau_t^r, & if \quad \tau_t^r \in [0,\bar{\tau}^r] \\ -\frac{(2-\beta)\tau_t^r}{2} + \frac{\beta(2-\beta)}{4} m + \frac{(2-\beta)\left(4\beta-2n\beta-m\beta^2+4\right)}{4(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}^r, 1] \end{cases}$$

where

$$\bar{\imath} \equiv \frac{2-\beta}{\beta+2}\,(1-n+m)$$

and

$$\bar{\tau}^r \equiv \frac{\beta-2}{2} m + \frac{(4n+4\beta+2m\beta-2n\beta-m\beta^2)}{2\,(\beta+2)}$$

(2) The equilibrium law of motion of τ_t^d is as follows

$$\tau_{t+1}^d = \begin{cases} 1-n+m, & if \quad \tau_t^d \in \left[0,\bar{\tau}_t^d\right] \\ -\frac{\tau_t^d+n-a_t^d}{2} + \frac{\beta+2}{4} m + \frac{8\beta-4n+2m\beta-6n\beta-m\beta^2+8}{4(\beta+2)}, & if \quad \tau_t^d \in \left(\bar{\tau}_t^d, 1-n+a_t^d\right] \end{cases}$$

where

$$\bar{\tau}_t^d \equiv \bar{\tau}_t^r - n + a_t^d$$

(3) The equilibrium law of motion of τ_t^r is

$$\tau_{t+1}^r = \begin{cases} 1, & if \quad \tau_t^r \in [0,\bar{\tau}_t^r] \\ -\frac{\tau_t^r}{2} + \frac{\beta-2}{4} m + \frac{\left(4n+8\beta+2m\beta-2n\beta-m\beta^2+8\right)}{4(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}_t^r, 1] \end{cases}$$

(4) Starting with any $a_0^d \in [0, m]$ *and* $i_{-1} \in [0, \bar{\imath}_{-1}]$, *then* $\tau_t^d \in \left(0, 1 - n + a_t^d\right)$ *and* $\tau_t^r \in (0, 1)$ *for all* $t \geq 0$. *Starting with any* $a_0^d \in [0, m]$ *and* $i_{-1} \in (\bar{\imath}_{-1}, 1 + \beta]$, *then* $\tau_t^d = 1 - n + a_0^d$, $\tau_0^r = 1$ *and* $\tau_t^d \in \left(0, 1 - n + a_t^d\right), \tau_t^r \in (0, 1)$ *for all* $t > 0$. *In each of the two cases, the economy converges asymptotically with an oscillatory pattern to the following steady state with*

$$a^{ss} = m$$

$$\tau_{ss}^d = \frac{1}{3\beta + 6}\left(4m - 4n + 4\beta + 4m\beta - 4n\beta + 4\right)$$

$$\tau_{ss}^r = \frac{2n - 2m + 4\beta + m\beta - n\beta + 4}{3\left(\beta + 2\right)}$$

$$i^{ss} = \frac{\left(-\beta^2 + \beta + 2\right)\left(m - n + 1\right)}{3\left(\beta + 2\right)}$$

Proof. See the Appendix. ■

Figure 3.1 represents the equilibrium decision rules of the incumbent ruler and the citizens when there is no Crown Prince problem. Panel a shows that the incumbent with any strength will choose the strongest successor. Panel b shows that for a given a_t^d, the equilibrium τ_t^d increases linearly with i_{t-1}, which is sunk in period t, before some threshold $\bar{\imath}_{t-1}$ and then achieves a corner solution with $\tau_t^d = 1 + n - a_t^d$ and a corresponding $\tau_t^r = 1$. Panel c shows that for a given a_{t+1}^d, the citizens' investment decreases with τ_t^r. The discontinuity at $\tau_t^r = \bar{\tau}_t^r$ reflects the fact that to the left of this point, the next period real tax rate, τ_{t+1}^r, will get a corner solution of one and the citizens' investment rule is different than that to the right. Intuitively, without the Crown Prince problem, an incumbent with any strength will choose the strongest successor, who distorts the least in i_t, since the citizens' investment increases with a_{t+1}^d. Given the choice of the strongest successor, the incumbent chooses a τ_t^d that ensures the tax income is at the peak of the Laffer curve, taking into account how the future ruler makes decisions about

the tax rate and the successor's strength. Obviously, in this case, the size of the tax base is the only concern of the ruler and there is no concern for safety due to the successor.

Figure 3.1: Decision Rules When There is No Crown Prince Problem

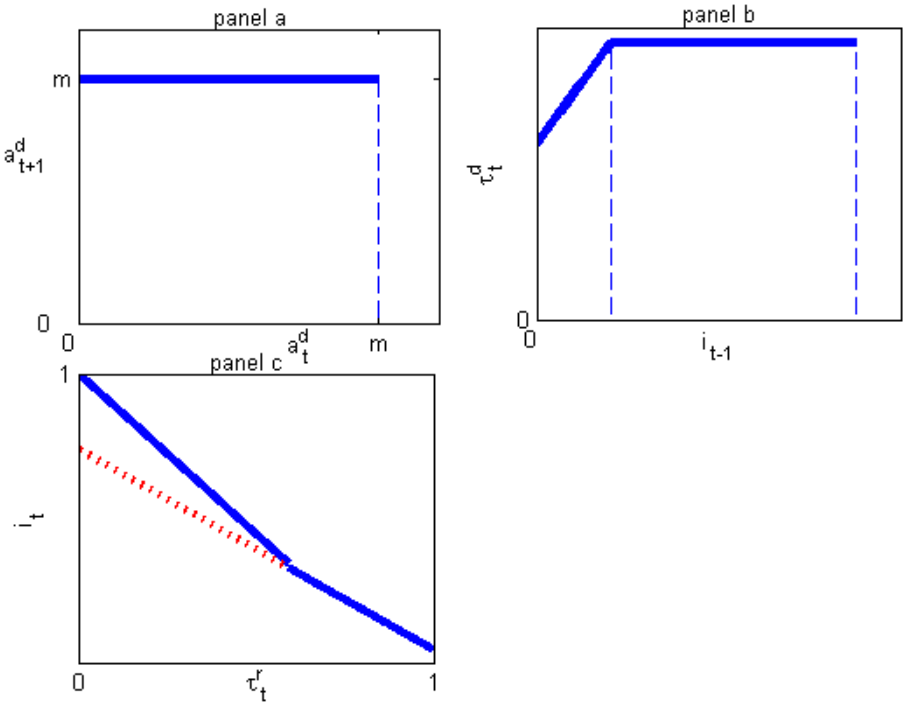


Figure 3.2 represents the equilibrium law of motion of tax rates. Panel a shows that if τ_t^d is lower than some threshold level $\bar{\tau}_t^d$, then τ_{t+1}^d will get a corner solution with $\tau_{t+1}^d = 1 + n - m$ and a corresponding $\tau_{t+1}^r = 1$, while if τ_t^d is higher than $\bar{\tau}_t^d$, then τ_{t+1}^d will decrease linearly with τ_t^d. The intuition is as follows, other things given, a lower τ_t^d will lead to a higher i_t, which is sunk seen in period $t+1$. This increases the period $t+1$ incumbent ruler's tax base and will be more heavily taxed. This will generate an oscillatory pattern of equilibrium τ_t^d across time. Panel b shows the equilibrium law of motion of τ_t^r. The shape and the mechanism are similar to the equilibrium law of motion of τ_t^d.

Figure 3.2: Equilibrium Law of Motion of Tax Rates When There is No Crown Prince

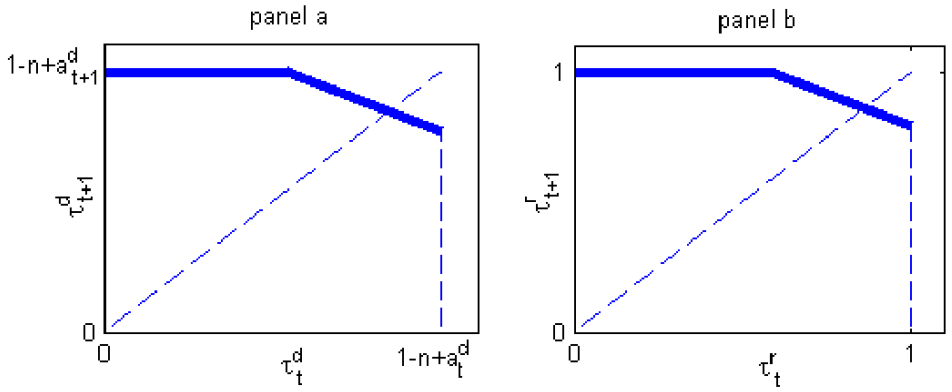


Figure 3.3: Time Series of Tax Rates When There is No Crown Prince Problem

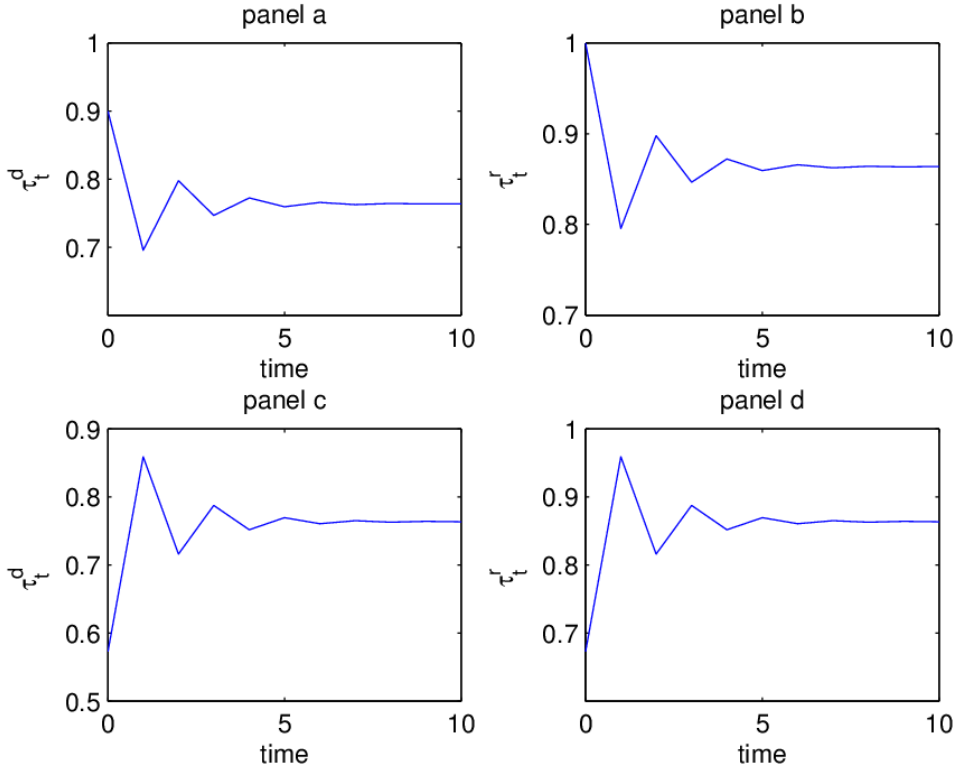


Figure 3.3 represents the time series of the tax rates. Panels a and b show that if $i_{-1} \in (\bar{\imath}_{-1}, 1+\beta]$, then τ_t^d and τ_t^r only get a corner solution at $t=0$. Panels c and d show that if $i_{-1} \in [0, \bar{\imath}_{-1}]$, then τ_t^d and τ_t^r never get a corner solution. In both cases, τ_t^d and τ_t^r converge asymptotically with an oscillatory pattern and without any trend to the same steady state.

3.4.2 Equilibrium with Crown Prince problem

This equilibrium can be analyzed in three steps. First, I solve the Markov Perfect Political Equilibrium where all incumbent rulers choose a sufficiently weak successor $\left(\frac{\alpha_t^d - \alpha_{t+1}^d}{\alpha_t^d} \geq d\right)$, and derive the indirect utility of the old incumbent ruler as a function of α_{t+1}^d for given i_{t-1} and α_t^d. Second, I analyze the case in which the old incumbent ruler in period t chooses a non-sufficiently weak successor $\left(-d \leq \frac{\alpha_i - \alpha_j}{\alpha_i} < d\right)$, given that all past and future rulers choose a sufficiently weak successor, and derive the indirect utility of the old incumbent ruler as a function of α_{t+1}^d for given i_{t-1} and α_t^d. Third, I derive the condition under which the indirect utility of the old incumbent in the first case is always higher than that in the second case for any i_{t-1} and α_t^d. If this condition holds, then by the one-stage deviation principle, the Markov Perfect Equilibrium where all incumbent dictators choose a sufficiently weak successor is a Subgame Perfect Nash Equilibrium without any restrictions on the successor's strength.

3.4.2.1 Equilibrium with a Sufficiently Weak Successor

In this case, the ruler's concern about safety dominates the concern of the tax base. This means $\frac{\alpha_t^d - \alpha_{t+1}^d}{\alpha_t^d} \geq d$ for all t. The timings of the game and the indirect utility functions of living agents in period t are the same as in the equilibrium without the Crown Price problem as there is no threat from the successor.

Definition 2. *A (Markov Perfect) Political Equilibrium is defined as a triplet*

of functions $\langle A, T, I\rangle$ *where* $A : [0,m] \times [0, 1-\beta] \to [0,m]$ *is the ruler's decision rule on the strength of his successor,* $a^d_{t+1} = A\left(a^d_t, i_{t-1}\right)$, $T : [0,m] \times [0, 1+\beta] \to \left[0, 1-n+a^d_t\right]$ *is the ruler's policy decision rule on the tax rate,* $\tau^d_t = T\left(a^d_t, i_{t-1}\right)$ *and* $I : [0,m] \times [0,1] \to [0, 1+\beta]$ *is the young citizens' private investment decision rule* $i_t = I\left(\alpha^d_{t+1}, \tau^r_t\right)$, *such that the following functional equations hold:*

1. $\left\{A\left(a^d_t, i_{t-1}\right), T\left(a^d_t, i_{t-1}\right)\right\} = \arg\max_{a^d_{t+1}, \tau^d_t} V^{od}\left(\tau^d_t, \tau^d_{t+1}, \alpha^d_{t+1}, \alpha^d_t, i_{t-1}\right)$

subject to $\tau^d_{t+1} = T\left(A\left(a^d_t, i_{t-1}\right), I\left(\alpha^d_{t+1}, \tau^r_t\right)\right)$ *and* $\frac{\alpha^d_t - \alpha^d_{t+1}}{\alpha^d_t} \geq d$.

2. $I\left(\alpha^d_{t+1}, \tau^r_t\right) = 1 - \tau^r_t + \beta\left(1 - \left(T\left(a^d_{t+1}, I\left(\alpha^d_{t+1}, \tau^r_t\right)\right) + n - \alpha^d_{t+1}\right)\right)$

3. $V^{od}\left(\tau^d_t, \tau^d_{t+1}, \alpha^d_{t+1}, \alpha^d_t, i_{t-1}\right) = \tau^d_t\left(i_{t-1} + I\left(\alpha^d_{t+1}, \tau^r_t\right)\right)$.

According to Definition 3, the state of the model economy in period t is captured by two state variables, a^d_t and i_{t-1}. The first equilibrium condition requires that a^d_{t+1} and τ^d_t maximize the indirect utility function of the old incumbent ruler, taking into account that the future rulers' decisions about the tax rate and the successor's strength depend on the current ruler's choice via the equilibrium decision rules. Moreover, it requires that $A\left(a^d_t, i_{t-1}\right)$ and $T\left(a^d_t, i_{t-1}\right)$ are both fixed points in the functional equation in part 1 of the definition. Furthermore, the constraint $\frac{\alpha^d_t - \alpha^d_{t+1}}{\alpha^d_t} \geq d$ needs to be satisfied as all rulers secure their power by choosing a sufficiently weak successor. The second equilibrium condition implies that all young citizens choose their investment optimally, given a^d_t and τ^r_t, and that the young agents hold rational expectations about how the future tax rate and the ruler's strength are determined. The third equilibrium condition means that the old incumbent does not need to worry about his safety since in this case, the sufficiently weak successor has no chance of winning the power struggle.

Proposition 2. *If* $m \leq n \leq 1$ *and* $0 < d < \frac{1-\beta}{2-\beta}$, *in the equilibrium with the crown prince problem but without any threat from the successor,* $\langle A, T, I\rangle$ *is characterized as follows:*

$$A\left(a^d_t, i_{t-1}\right) = (1-d)\, a^d_t$$

$$T\left(a_t^d, i_{t-1}\right) = \begin{cases} \frac{1}{2-\beta} i_{t-1} + \frac{1+\beta(1-d)}{2+\beta(1-d)} a_t^d + \frac{1+\beta-n-n\beta}{2+\beta}, & if \quad i_{t-1} \in [0, \bar{i}_{t-1}] \\ 1+n-a_t^d, & if \quad i_{t-1} \in (\bar{i}_{t-1}, 1+\beta] \end{cases}$$

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = \begin{cases} 1-\tau_t^r, & if \quad \tau_t^r \in [0, \bar{\tau}_t^r] \\ -\frac{(2-\beta)\tau_t^r}{2} + \frac{\beta(2-\beta)\alpha_{t+1}^d}{2(2+\beta(1-d))} + \frac{(2-\beta)(2\beta-n\beta+2)}{2(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}_t^r, 1] \end{cases}$$

for given a_0^d *and all* t*, where*

$$\bar{i}_{t-1} \equiv (2-\beta)\left(\frac{(1-n)}{2+\beta} + \frac{a_t^d}{2+\beta(1-d)}\right)$$

$$\bar{\tau}_t^r \equiv \frac{(\beta-2)\,\alpha_{t+1}^d}{(2+\beta(1-d))} + \frac{1}{\beta+2}(2n+2\beta-n\beta)$$

Furthermore,

1. The equilibrium law of motion of τ_t^d *is as follows*

$$\tau_{t+1}^d = \begin{cases} 1-n+a_t^d, & if \quad \tau_t^d \in \left[0, \bar{\tau}_t^d\right] \\ -\frac{\tau_t^d+n-a_t^d}{2} + \left[\frac{2+2\beta(1-d)+\beta}{2(2+\beta(1-d))}\right]\alpha_{t+1}^d & \\ +\frac{1}{2(\beta+2)}(4\beta-2n-3n\beta+4), & if \quad \tau_t^d \in \left(\bar{\tau}_t^d, 1-n+a_t^d\right] \end{cases}$$

where

$$\bar{\tau}_t^d \equiv \bar{\tau}_t^r - n + a_t^d$$

2. The equilibrium law of motion of τ_t^r*, is as follows*

$$\tau_{t+1}^r = \begin{cases} 1, & if \quad \tau_t^r \in [0, \bar{\tau}_t^r] \\ -\frac{\tau_t^r}{2} - \left[\frac{2-\beta}{2(2+\beta(1-d))}\right]\alpha_{t+1}^d & \\ +\frac{1}{2(\beta+2)}(2n+4\beta-n\beta+4), & if \quad \tau_t^r \in (\bar{\tau}_t^r, 1] \end{cases}$$

3. Starting with any $a_0^d \in [0, m]$ *and* $i_{-1} \in [0, \bar{i}_{-1}]$*, then* $0 < \tau_t^r < 1$ *for all* $t \geq 0$*. Starting with any* $a_0^d \in [0, m]$ *and* $i_{-1} \in [\bar{i}, 1+\beta]$*, then* $\tau_0^r = 1$ *and*

$0 < \tau_t^r < 1$ *for all* $t > 0$, *where*

$$\bar{\imath}_{-1} = (2-\beta)\left(\frac{(1-n)}{2+\beta} + \frac{a_0^d}{2+\beta\,(1-d)}\right)$$

In each of the above two cases, the economy converges asymptotically with an oscillatory pattern to the following steady state with

$$a^{ss} = 0$$

$$\tau_{ss}^d = \frac{4\,(\beta+1)\,(1-n)}{3\,(\beta+2)}$$

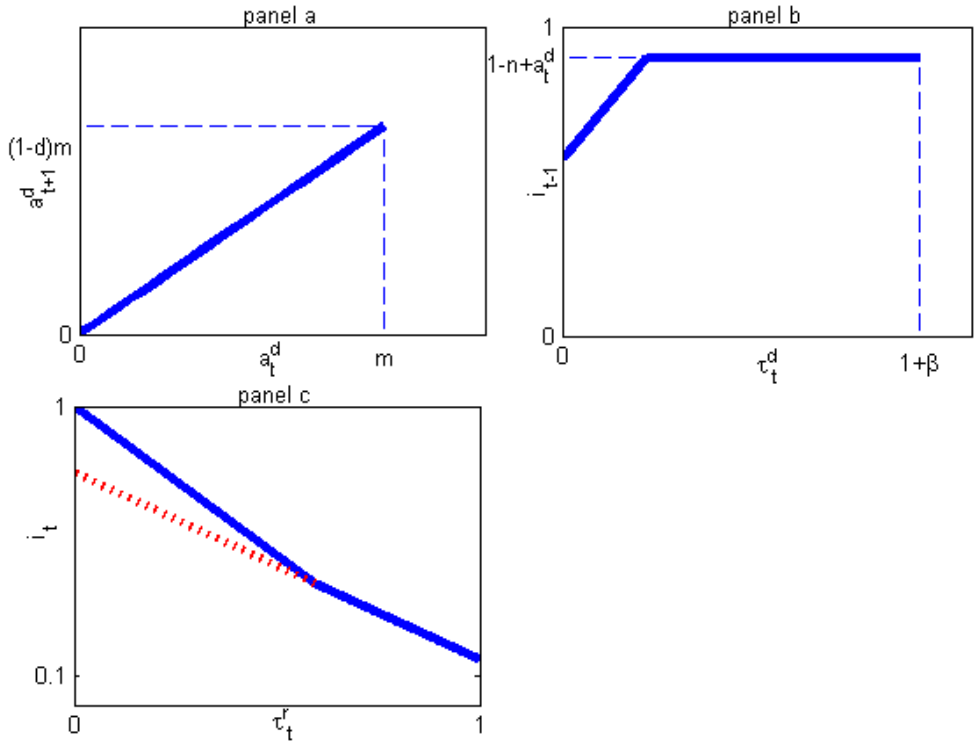
$$\tau_{ss}^r = \frac{1}{3\,(\beta+2)}\,(2n+4\beta-n\beta+4)$$

$$i_{ss} = \frac{1}{3\,(\beta+2)}\left(-\beta^2+\beta+2\right)(1-n)$$

Proof. See the Appendix. ■

Figure 3.4 represents the equilibrium decision rules of the incumbent ruler and the citizens when there is no Crown Prince problem. Panel a shows that the successor's strength increases linearly with the incumbent's strength. Panel b shows that for given a_t^d, the equilibrium τ_t^d increases linearly with i_{t-1}, which is sunk in period t, before some threshold $\bar{\imath}_{t-1}$ and then achieves a corner solution with $\tau_t^d = 1 + n - a_t^d$ and a corresponding $\tau_t^r = 1$ henceforth. Panel c shows that for a given a_{t+1}^d, the citizens' investment decreases with τ_t^r. The kink at $\tau_t^r = \bar{\tau}_t^r$ reflects the fact that to the left of this point, the next period real tax rate, τ_{t+1}^r, will get a corner solution of one and the citizens' investment rule is different from that to the right. Intuitively, when there is a Crown Prince problem, the ruler's choice of a_{t+1}^d and τ_t^d can be separate, given the model's assumption about agents' preferences and how the winner

Figure 3.4: Decision Rules When the Incumbent Chooses a Suffciently Weak Successor



of the power struggle is determined. That is, first, to ensure his safety, an incumbent with any strength will choose a successor who is is sufficiently weak (the constraint $\frac{\alpha^d_t - \alpha^d_{t+1}}{\alpha^d_t} \geq d$ is satisfied). Second, to minimize the distortion on investment, the constraint $\frac{\alpha^d_t - \alpha^d_{t+1}}{\alpha^d_t} \geq d$ needs to be binding. Third, given the choice of the successor, the incumbent chooses a τ^d_t that ensures the total tax revenue is on the peak of the Laffer curve, taking into account how the future ruler makes decisions about the tax rate and the successor's strength.

Figure 3.5 represents the equilibrium law of motion of tax rates. Panel a shows that if τ^d_t is lower than some threshold level $\bar{\tau}^d_t$, τ^d_{t+1} will get a corner solution with $\tau^d_{t+1} = 1 + n - a^d_t$ and a corresponding $\tau^r_{t+1} = 1$, while if τ^d_t is higher than $\bar{\tau}^d_t$, τ^d_{t+1} will decrease linearly with τ^d_t. The intuition is as follows: Other things given, a lower τ^d_t will lead to a higher i_t, which is sunk in period

Figure 3.5: Equilibrium Law of Motion of Tax Rates When the Incumbent Chooses a Suffciently Weak Successor

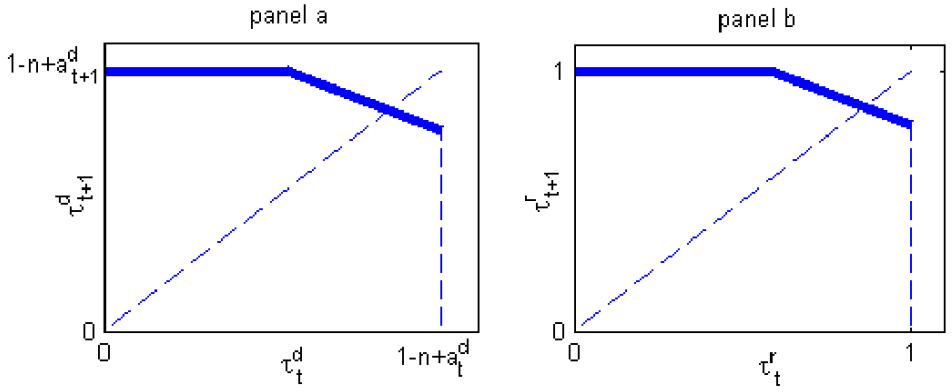
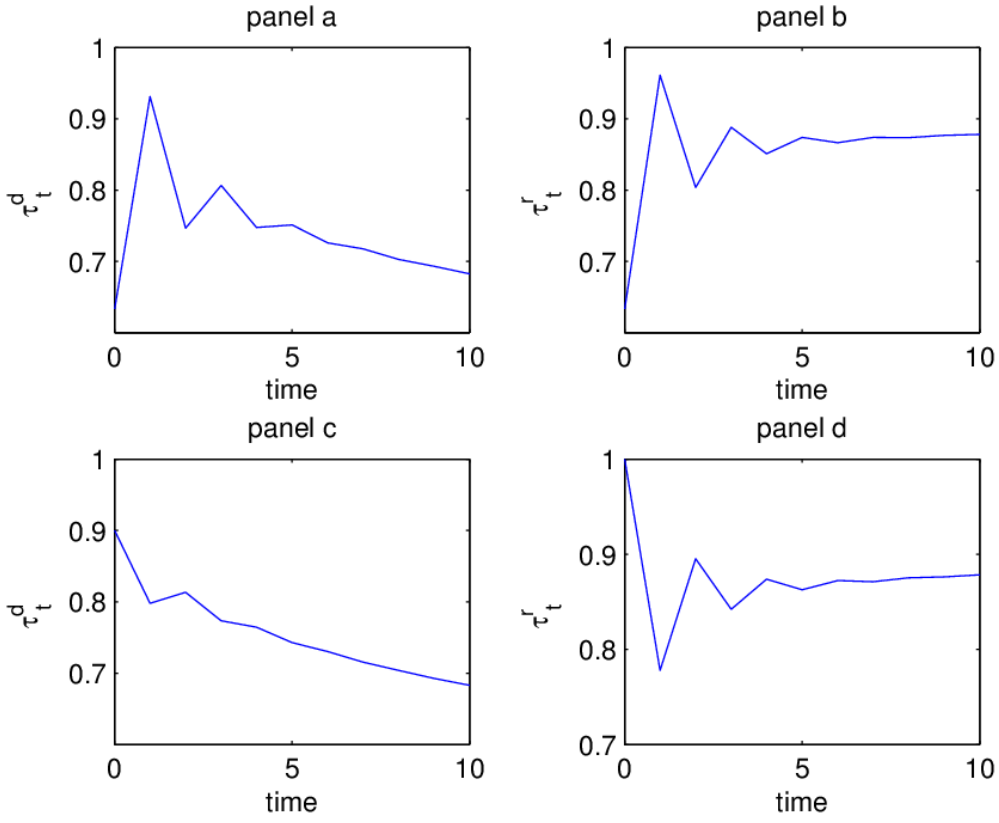


Figure 3.6: Time Series of Tax Rates When the Incumbent Chooses a Sufficiently Weak



$t+1$. This increases the period $t+1$ incumbent ruler's tax base and will be more heavily taxed. This will generate an oscillatory pattern of τ_t^d. Panel b shows the equilibrium law of motion of τ_t^r. The oscillatory pattern is due to the fact that τ_t^d is oscillatory.

Figure 3.6 represents the time series of the tax rates. Panels a and b show that if $i_{-1} \in [0, \bar{\imath}_{-1}]$, then τ_t^d and τ_t^r get a corner solution only at $t = 0$. Panels c and d show that if $i_{-1} \in (\bar{\imath}_{-1}, 1+\beta]$, then τ_t^d and τ_t^r never get a corner solution. In both cases, τ_t^d converges asymptotically with an oscillatory pattern and a *downward* trend to the steady state. The *downward* trend is reflected in the term $\left[\frac{2+2\beta(1-d)+\beta}{2(2+\beta(1-d))}\right]\alpha_{t+1}^d$ in the equilibrium law of motion of τ_t^d as this term is decreasing period by period due to decreasing α_{t+1}^d. Also in both cases, τ_t^r converges asymptotically with an oscillatory pattern and an *upward* trend to the steady state. The *upward* trend is reflected in the term $-\left[\frac{2-\beta}{2(2+\beta(1-d))}\right]\alpha_{t+1}^d$ in the equilibrium law of motion of τ_t^r as this term is increasing period by period due to a decreasing α_{t+1}^d.

The mechanism for generating the trends is as follows. On the one hand, as the ruler's strength becomes weaker with time, the bureaucratic surcharge increases with time. On the other hand, the ruler needs to consider the fact that the real tax burden (the tax rate plus the surcharge rate) should be smaller than one. As the surcharge is increasing, the room for the ruler to set the tax rate is eroded by the bureaucrats by and by and the Laffer curve shifts to the left. This drives down the tax rate set by the ruler. However, the real burden faced by the citizens is increasing over time because of the increasing surcharge. From the opposing trends of τ_t^d and τ_t^r, it is straightforward to see that an increasing fraction of the tax revenue ends up with the bureaucrats. This distorts the citizens' incentive to invest and shrinks the tax base of the ruler. This, plus the fact that the ruler has less room for setting the tax rate, leads to a shrinking tax revenue to the ruler.

3.4.2.2 Equilibrium with a Threat from the Successor

Now I explore the following question: given that all past and future rulers choose a sufficiently weak successor, is it optimal for the current ruler in period t to deviate from choosing a sufficiently weak successor or, equivalently, to choose an insufficiently weak successor ($-d \leq \frac{\alpha_t^d - \alpha_{t+1}^d}{\alpha_t^d} \leq d$)? If the answer is no, then by the one-stage deviation principle, the Markov Perfect Political Equilibrium where all incumbent rulers choose sufficiently weak successors is a Subgame Perfect Nash Equilibrium.

As there is now a threat from the successor and the result of the political struggle is probabilistic, the timing of the game in period t is modified as follows:

1. At the beginning of period t, the old incumbent ruler chooses his successor with strength α_{t+1}^d;

2. The successor candidates other than the one chosen by the ruler as successor and the one with strength $\alpha_{t+1}^d + \varepsilon$, with $\varepsilon \to 0$, are eradicated[1];

3. The old incumbent sets the tax rate τ_t^d;

4. The young citizens born in period t make their investment i_t;

5. The bureaucrats surcharge $n - \alpha_t^d$ and collect the tax;

6. The power struggle between the incumbent and the successor takes place;

[1]If there is a power struggle between the incumbent and the successor in period t, then a potential question is, who will be the ruler in period $t+1$ if the successor loses the power struggle in period t. For simplicity, I assume that the ruler keeps a candidate with almost the same strength as the successor and if the successor loses in the power struggle, the incumbent transfers his power to the candidate with strength $\alpha_t^s + \varepsilon$ at the end of period t, and there is no further power struggle. This assumption is made for simplicity. With this assumption, the equilibrium tax rate and the young citizens' investment will not be affected by the political struggle.

7. If the old incumbent wins, the successor is replaced with the candidate with strength $\alpha_{t+1}^d + \varepsilon$ at the end of period t.

8. If the successor wins, he gets the tax income in period t and also rules in period $t+1$. In this case, the utility of the old incumbent is Ψ.

Giving the timing of the game, the indirect utility function of the old incumbent to choose a non-sufficiently weak successor in period t is

$$V_{nsw}^{od} = \frac{1}{2}\tau_t^d \left(i_{t-1} + i_t\right) + \frac{1}{2}\Psi$$

This indirect utility function consists of two terms: with probability $\frac{1}{2}$, the old incumbent can maintain his power and get the tax at period t; and with probability $\frac{1}{2}$, he loses the power and the utility of being removed is Ψ. Furthermore, as the power struggle in period t takes place after the strength of the successor (or equivalently, the strength of the period $t+1$ ruler), the tax rate τ_t^d and the real tax rate τ_t^r are determined, no matter who wins the power struggle in period t, the citizens' investment decision rule will be the same as in the case when all incumbents choose sufficiently weak successors.

Proposition 3. *If*

$$\Psi < \min \left\{ \begin{array}{c} (2-\beta)\left(\frac{2(1-n)^2(1+\beta)^2-(\beta+2)^2\left(\frac{3+\beta(1-d)}{4+2(1-d)}m+\frac{(1-n)(1+\beta)}{\beta+2}\right)^2}{2(\beta+2)^2}\right), \\ \frac{2(2-\beta)(1-n)^2(1+\beta)^2-(\beta+2)^2(2+\beta-n+m)^2}{2(\beta+2)^2} \end{array} \right\},$$

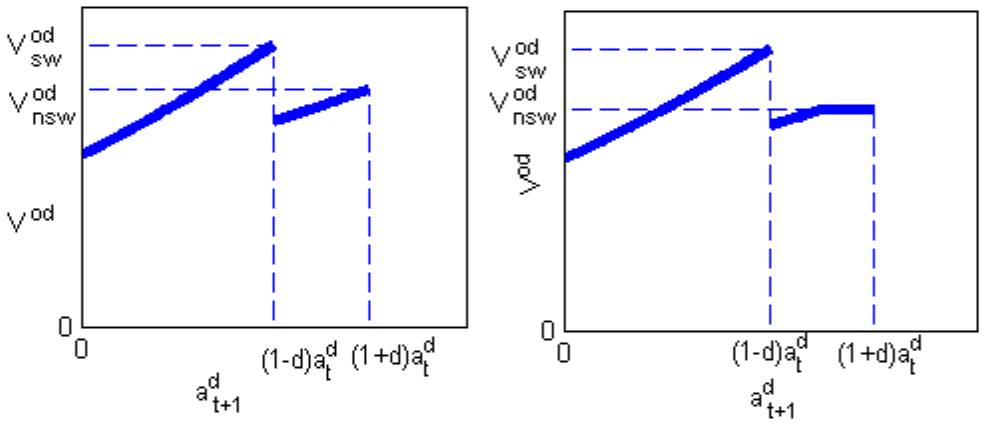
all rulers will choose a sufficiently weak successor and the Markov Perfect Political Equilibrium defined in Definition 3, but without the constraint

$$\frac{\alpha_t^d - \alpha_{t+1}^d}{\alpha_t^d} \geq d$$

is a Subgame Perfect Nash Equilibrium.

The intuition of this Proposition is that, if the utility Ψ of the old incumbent from being replaced by the successor is sufficiently low, then any ruler will rather be concerned about his own safety than about his rent. Therefore, all rulers will choose a sufficiently weak successor. Figure 3.7 illustrates the relationship between the incumbent's utility and a_{t+1}^d for given a_t^d and i_{t-1}. In panel a, V^{od} increases by a_{t+1}^d for all $a_{t+1}^d \in \left((1-d)\, a_t^d, \min\left\{(1+d)\, a_t^d, m\right\}\right]$, and if Ψ is sufficiently low, the incumbent's indirect utility from choosing a sufficiently weak successor(V_{sw}^{od}) is higher than that from choosing a non-sufficiently weak successor$\left(V_{nsw}^{od}\right)$. In panel b, V^{od} increases by a_{t+1}^d for all $a_{t+1}^d \in \left((1-d)\, a_t^d, \bar{a}_{t+1}^d\right]$ and gets a corner solution henceforth because τ_{t+1}^r will get a corner solution of one for $a_{t+1}^d \in \left(\bar{a}_{t+1}^d, \min\left\{(1+d)\, a_t^d, m\right\}\right]$. In this case, sufficiently low Ψ also ensures that the incumbent's indirect utility from choosing a sufficiently weak successor(V_{sw}^{od}) is higher than that of choosing a non-sufficiently weak successor$\left(V_{nsw}^{od}\right)$.

Figure 3.7: Time Series of Tax Rates When the Incumbent Chooses a Sufficiently Weak



Combining all the analysis, the main result of the paper can be summarized as follows. If all rulers' utility of losing power is sufficiently low, which leads them to be concerned primarily on his own safety, then

1. The ruler will become weaker and weaker period by period.

2. Bureaucratic corruption will become larger and larger.

3. The real tax rate faced by the citizens, τ_t^r, will become higher and higher, which makes the tax base smaller and smaller.

4. The fraction of tax income that goes to the ruler, τ_t^d, will become lower and lower.

5. The political regime can hardly survive in the long run, due to the increasing burden on the citizens and the decreasing fiscal revenue to the ruler.

3.5 Discussion and conclusion

In this paper, I construct a positive theory on the dynastic cycle. The main contribution of the analysis consists of showing that the dynastic cycle is inevitable if there is discontinuity of power caused by the ruler's physical death and the delegation of the ruler's unbalanced power, which are two common properties shared by all dictatorial regimes. More specifically, I have identified two opposing effects with which the incumbent ruler is concerned when determining his successor. The first is the *tax base effect*. Since the functions of dictatorship depend a great deal on the quality of the leader, a stronger future ruler will increase the investment of forward looking citizens. This increases the incumbent's tax base. The second is the *safety effect*. That is, a stronger successor is always more dangerous to the incumbent, as the former always has an incentive to take the place of the latter and enjoy the power earlier. If every incumbent is primarily concerned about his own safety rather than the tax base, the *safety effect* will dominate the *tax base effect* and the quality of the successor, or the future ruler, will be lower and lower. The unnatural selection of the successor is not costless, because weaker rulers are worse at regulating the bureaucrats and bureaucratic corruption, which is modeled as bureaucrats' surcharge of tax, will tend to increase generation

by generation. The overall pattern of a dynasty is that the increasing burden on the citizens caused by increasing the bureaucrats' tax surcharge due to a weakening ruler, and the fiscal revenue of the ruler is decreasing due to the decrease of the tax base. Both will contribute to the collapse of the dynasty in the long run.

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3.7 Technical Appendix

3.7.1 Proof of Proposition 1

3.7.1.1 The decision rules

I will use "guess and verify" strategy to derive the incumbent's decision rules of the successor's strength and the tax rate, and the citizens' decision rule of the investment.

Start by guessing $\tau_t^d = Ai_{t-1} + B\alpha_t^d + C$ for all t and ignoring the constraint $\tau_t^d \in \left[0, 1-n+a_t^d\right]$. Given this guess, we must have

$$\tau_{t+1}^d = Ai_t + B\alpha_{t+1}^d + C$$

and

$$\begin{aligned} \tau_{t+1}^r &= \tau_{t+1}^d + n - \alpha_{t+1}^d \\ &= Ai_t + (B-1)\,\alpha_{t+1}^d + C + n \end{aligned}$$

Plug the expression of τ_{t+1}^r in (3.2), we get

$$i_t = 1 - \tau_t^d - n + \alpha_t^d + \beta\left(1 - Ai_t - (B-1)\,\alpha_{t+1}^d - C - n\right) \tag{3.3}$$

Solve for i_t in (3.3), we have

$$i_t = \frac{1 - \tau_t^d - n + \alpha_t^d + \beta\left(1 - (B-1)\,\alpha_{t+1}^d - C - n\right)}{1+\beta A} \tag{3.4}$$

Plug (3.4) in the indirect utility function of the old incumbent and rearrange, we have

$$V^{od} = \tau_t^d\left(i_{t-1} + \frac{1 - \tau_t^d - n + \alpha_t^d + \beta\,(1 - C - n)}{1+\beta A} + \frac{\beta\,(1-B)\,\alpha_{t+1}^d}{1+\beta A}\right) \tag{3.5}$$

As we can see from (3.5), given the guess about the expression of τ_t^d, the incumbent's decisions of the successor's strength and the tax rate can be separate now. That is, if $\frac{\beta(1-B)}{1+\beta A} > 0$,then for any i_{t-1}, τ_t^d,and α_t^d, the incumbent will choose $\alpha_{t+1}^d = m$, since this maximizes his tax base; if $\frac{\beta(1-B)}{1+\beta A} \leq 0$, the incumbent will choose $\alpha_{t+1}^d = 0$, for any i_{t-1}, τ_t^d,and α_t^d. Once α_{t+1}^d is determined, the incumbent just chooses a τ_t^d to ensure his tax revenue is on the peak of Laffer curve.

My following strategy is to suppose $\frac{\beta(1-B)}{1+\beta A} > 0$, plug in $\alpha_{t+1}^d = m$ in

(3.5), get a solution candidate $\{A_1, B_1, C_1\}$ of $\{A, B, C\}$, and then to verify in this case, $\frac{\beta(1-B_1)}{1+\beta A_1} > 0$. Then I suppose $\frac{\beta(1-B)}{1+\beta A} \leq 0$ and plug in $\alpha_{t+1}^d = 0$ in (3.5), get a solution candidate $\{A_2, B_2, C_2\}$ of $\{A, B, C\}$ and then to verify in this case, $\frac{\beta(1-B_2)}{1+\beta A_2} \leq 0$ does not hold. With this strategy, I can show that $\{A_1, B_1, C_1\}$ is the solution of $\{A, B, C\}$.

Suppose $\frac{\beta(1-B)}{1+\beta A} > 0$, then $\alpha_{t+1}^d = m$. Plug $\alpha_{t+1}^d = m$ into (3.5), we get

$$\begin{aligned} V^{od} &= \frac{\tau_t^d}{A_1\beta + 1}\left(\alpha_t^d + \beta\left(1 - B_1\right)m + 1 + \beta - n - C_1\beta - n\beta\right) \\ &\quad + \tau_t^d i_{t-1} - \frac{\left(\tau_t^d\right)^2}{A_1\beta + 1} \end{aligned} \tag{3.6}$$

Take first order condition in (3.6) with respect to τ_t^d, we get

$$\tau_t^d = \frac{\left(1 + A_1\beta\right)i_{t-1} + \alpha_t^d + \beta\left(1 - B_1\right)m + 1 + \beta - n - C_1\beta - n\beta}{2} \tag{3.7}$$

As we have guessed

$$\tau_t^d = Ai_{t-1} + B\alpha_t^d + C$$

for all t and we get an expression of τ_t^d in (3.7), then the following equality must hold for all t if the guess is correct

$$\begin{aligned} &\frac{\left(1 + A_1\beta\right)i_{t-1} + \alpha_t^d + \beta\left(1 - B_1\right)m + 1 + \beta - n - C_1\beta - n\beta}{2} \\ = \;& A_1 i_{t-1} + B_1\alpha_t^d + C_1 \end{aligned} \tag{3.8}$$

If (3.8) holds for all t, the following equation system must hold

$$\begin{cases} \frac{1+A_1\beta}{2} = A_1 \\ B_1 = \frac{1}{2} \\ \frac{\beta(1-B_1)m+1+\beta-n-C_1\beta-n\beta}{2} = C_1 \end{cases}$$

Solving the above equation system, we get

$$\begin{cases} A_1 = \frac{1}{2-\beta} \\ B_1 = \frac{1}{2} \\ C_1 = \frac{\frac{\beta m}{2}+1+\beta-n-n\beta}{2+\beta} \end{cases}$$

Since $A_1 = \frac{1}{2-\beta}$ and $B_1 = \frac{1}{2}$, then $\frac{\beta(1-B_1)}{1+\beta A_1} = \frac{\beta(2-\beta)}{4} > 0$ for $\beta \in (0,1)$. This means $\{A_1, B_1, C_1\}$ is one solution of $\{A, B, C\}$.

Suppose $\frac{\beta(1-B)}{1+\beta A} \leq 0$ instead, then $\alpha_{t+1}^d = 0$. Performing exactly the same steps above as in deriving $\{A_1, B_1, C_1\}$, we get

$$\begin{cases} A_2 = \frac{1}{2-\beta} \\ B_2 = \frac{1}{2} \\ C_2 = \frac{1+\beta-n-n\beta}{2+\beta} \end{cases}$$

However, in this case, $\frac{\beta(1-B_2)}{1+\beta A_2} = \frac{\beta(2-\beta)}{4} > 0$ for $\beta \in (0,1)$. This contradicts our suppose $\frac{\beta(1-B)}{1+\beta A} \leq 0$. Therefore, $\{A_2, B_2, C_2\}$ is not the solution of $\{A, B, C\}$ and we conclude that

$$\begin{cases} A = A_1 = \frac{1}{2-\beta} \\ B = B_1 = \frac{1}{2} \\ C = C_1 = \frac{\frac{\beta m}{2}+1+\beta-n-n\beta}{2+\beta} \end{cases}$$

Now consider the constraint $\tau_t^d \in \left[0, 1+n-a_t^d\right]$. This can be done in two steps. Firstly, consider the constraint

$$\tau_t^d \geq 0 \tag{3.9}$$

With the solution of $\{A, B, C\}$, (3.9) can be rewritten and simplified as

$$n \leq \frac{2+\beta}{(2-\beta)(1+\beta)} i_{t-1} + \frac{2+\beta}{2(1+\beta)} a_t^d + \frac{\beta m}{2(1+\beta)} + 1 \tag{3.10}$$

In order for (3.10) to hold for all $i_{t-1} \in [0, 1+\beta]$ and $a_t^d \in [0, m]$, (10) must hold when evaluating at $i_{t-1} = 0$ and $a_t^d = 0$ since the RHS of (3.10) achieves its minimum in this case. With this findings, the necessary and sufficient condition for (3.10) to hold is

$$n \leq \frac{\beta m}{2(1+\beta)} + 1 \tag{3.11}$$

Secondly, consider the constraint

$$\tau_t^d \leq 1 - n + a_t^d \tag{3.12}$$

With the solution of $\{A, B, C\}$, (3.12) can be rewritten as

$$\frac{1}{2-\beta} i_{t-1} + \frac{1}{2} a_t^d + \frac{\frac{\beta m}{2} + 1 + \beta - n - n\beta}{2+\beta} \leq 1 - n + a_t^d \tag{3.13}$$

Simplifying (3.13), we get

$$n - a_t^d \leq \frac{\beta}{2} a_t^d - \frac{\beta m}{2} - \frac{2+\beta}{2-\beta} i_{t-1} + 1 \tag{3.14}$$

For given a_t^d, in order for (3.14) to hold for all $i_{t-1} \in [0, 1+\beta]$, (3.14) must hold when evaluating at $i_{t-1} = 1+\beta$ because $-\frac{2+\beta}{2-\beta} < 0$ for $\beta \in (0, 1)$. Evaluating (3.14) at $i_{t-1} = 1+\beta$, we get

$$n - a_t^d \leq \frac{\beta}{2} a_t^d - \frac{\beta m}{2} - \frac{(2+\beta)(1+\beta)}{2-\beta} + 1 \tag{3.15}$$

Simplifying (3.15), we get

$$n - a_t^d \leq \frac{\beta}{2}\left(a_t^d - m\right) - \frac{\beta(4+\beta)(1+\beta)}{2-\beta} \tag{3.16}$$

The RHS of (3.16) must be negative because the term $-\frac{\beta(4+\beta)(1+\beta)}{2-\beta}$ is

negative for $\beta \in (0,1)$ and the term $\frac{\beta}{2}\left(a_t^d - m\right)$ is larger or equal to zero for $a_t^d \in [0,m]$. The LHS of (3.16) is bureaucrats' surcharge, which must be larger or equal to zero by assumption. Therefore, there is a contradiction and (3.14) can not hold for all $i_{t-1} \in [0, 1+\beta]$. This means for given a_t^d, τ_t^d gets a corner solution with

$$\tau_t^d = 1 - n + a_t^d$$

when i_{t-1} is larger than some threshold value $\bar{\imath}_{t-1} < 1+\beta$, which can be derived by equalizing the two sides of (3.13), with

$$\bar{\imath}_{t-1} = \frac{2-\beta}{\beta+2}\left(1 - n - \frac{1}{2}m\beta + a_t^d + \frac{1}{2}\beta a_t^d\right) \tag{3.17}$$

To avoid corner solution of τ_t^d for all $i_{t-1} \in [0, 1+\beta]$, $\bar{\imath}_{t-1}$ should be positive and this can be transferred to the following condition

$$n < 1 - \frac{1}{2}m\beta + a_t^d + \frac{1}{2}\beta a_t^d \tag{3.18}$$

for all $a_t^d \in [0,m]$. This condition is equivalent to

$$n < 1 - \frac{1}{2}m\beta \tag{3.19}$$

where the RHS of (3.19) is derived by evaluating the RHS of (3.18) at $a_t^d = 0$.

Comparing (3.11) and (3.19), we can find that (3.11) must hold if (3.19) holds because of positive β and m. At this moment, we can *conjecture* that if $n < 1 - \frac{1}{2}m\beta$ and if there is no Crown Prince problem, the incumbent ruler's decision rule about successor is

$$A\left(a_t^d, i_{t-1}\right) = m$$

and the decision rule about tax rate is

$$T\left(a_t^d, i_{t-1}\right) = \begin{cases} \frac{1}{2-\beta} i_{t-1} + \frac{1}{2} a_t^d + \frac{\frac{\beta m}{2}+1+\beta-n-n\beta}{2+\beta}, & if \quad i_{t-1} \in [0, \bar{\imath}_{t-1}] \\ 1-n+a_t^d, & if \quad i_{t-1} \in (\bar{\imath}_{t-1}, 1+\beta] \end{cases} \tag{3.20}$$

With the conjecture in (3.20), the citizens' decision rule of investment can be derived in two steps.

Firstly, if $0 \leq i_t \leq \bar{\imath}_t$ due to a high $\tau_t^r \in (\bar{\tau}_t^r, 1]$, where $\bar{\imath}_t$ is derived by moving one period forward in (3.17):

$$\bar{\imath}_t = \frac{2-\beta}{\beta+2}\left(1-n-\frac{1}{2}m\beta + a_{t+1}^d + \frac{1}{2}\beta a_{t+1}^d\right) \tag{3.21}$$

and citizens' decision rule of investment in this case can be derived by plugging in the values of A, B and C in (3.4):

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = -\frac{(2-\beta)\,\tau_t^r}{2} + \frac{\beta\,(2-\beta)}{4} a_{t+1}^d + \frac{(2-\beta)\,(4\beta - 2n\beta - m\beta^2 + 4)}{4\,(\beta+2)} \tag{3.22}$$

The threshold level $\bar{\tau}_t^r$ can be derived by plugging the (3.21) into (3.22) for investment and solving for the corresponding real tax rate with

$$\bar{\tau}_t^r = \frac{\beta-2}{2} a_{t+1}^d + \frac{(4n+4\beta+2m\beta-2n\beta-m\beta^2)}{2\,(\beta+2)} \tag{3.23}$$

Secondly, if $\bar{\imath}_t < i_t \leq 1+\beta$ due to $\tau_t^r \in [0, \bar{\tau}_t^r]$, then according to incumbent's rule of tax rate in (3.20),

$$\tau_{t+1}^d = 1 - n + a_t^d$$

and

$$\tau_{t+1}^r = 1$$

The citizens' decision rule of investment in this case can be derived by plug-

ging $\tau^r_{t+1} = 1$ in (3.2) with

$$I\left(\alpha^d_{t+1}, \tau^r_t\right) = 1 - \tau^r_t \tag{3.24}$$

From (3.22) and (3.24), we can see the citizens' decision rule of investment is stepwise. Due to this, there can be a problem with the *conjecture* in (3.20). That is, if the real tax rate at period t is smaller than $\bar{\tau}^r_t$ due to a low i_{t-1}, then expecting the next period real rate will be a corner solution that equals to one, the citizens' decision rule will be the expression in (3.24). If we plug (3.24) in the indirect utility function of the old incumbent and redo the guessing and verifying, we can get another decision rule about tax rate of the incumbent, which will be different than what we get (3.20). This will make the problem complictated. In the following step, we will show that given $n < 1 - \frac{1}{2}m\beta$, the real tax rate at period t can never be smaller than $\bar{\tau}^r_t$. With this result, we can rule out of the possibility that there is a low i_{t-1} which makes a real tax rate rate lower than $\bar{\tau}^r_t$.

From (3.20), we can see that for given α^d_t, τ^d_t and τ^r_t achieve their minimum when $i_{t-1} = 0$. If we can show the minimum of τ^r_t, which is denoted as $\tau^{r\,\min}_t$, is higher than $\bar{\tau}^r_t$, then we can conclude that τ^r_t will always be higher than $\bar{\tau}^r_t$. $\tau^{r\,\min}_t$ can be solved by plugging $i_{t-1} = 0$ into (3.20) and adding $n - a^d_t$ on both sides:

$$\tau^{r\,\min}_t = n - \frac{1}{2}a^d_t + \frac{\frac{\beta m}{2} + 1 + \beta - n - n\beta}{2 + \beta} \tag{3.25}$$

By (3.23) and (3.25), the difference between $\tau^{r\,\min}_t$ and $\bar{\tau}^r_t$ is

$$\tau^{r\,\min}_t - \bar{\tau}^r_t = \frac{(1-\beta)\left(1 - \frac{1}{2}m\beta - n\right)}{\beta + 2} - \frac{1}{2}a^d_t - \frac{\beta - 2}{2}a^d_{t+1} \tag{3.26}$$

From our conjecture about the incumbent's decision rule about sucessor's strength, we know $a^d_{t+1} = m$ for all $t \geq 0$. Inspecting (3.26), we can see that

given $a_{t+1}^d = m$, the minimum difference between $\tau_t^{r\,\min}$ and $\bar{\tau}_t^r$ is obtained when $a_t^d = m$, and this minimum value is

$$\left(\tau_t^{r\,\min} - \bar{\tau}_t^r\right)_{\min} = \frac{(1-\beta)\left(1 - \frac{1}{2}m\beta - n\right)}{\beta + 2} + \frac{1}{2}m\,(1-\beta)$$

As we can see, given $n < 1 - \frac{1}{2}m\beta$, $\beta \in (0,1)$ and $m > 0$, $\left(\tau_t^{r\,\min} - \bar{\tau}_t^r\right)_{\min}$ must be positive and we can conclude that $\tau_t^r > \bar{\tau}_t^r$ for all t. Therefore, the conjecture about the incumbent's decision rules in (3.20) is correct.

Given the ruler's decision rules, the citizens' decision rule of investment is

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = \begin{cases} 1 - \tau_t^r, & if \quad \tau_t^r \in [0, \bar{\tau}_t^r] \\ -\frac{(2-\beta)\tau_t^r}{2} + \frac{\beta}{4}a_{t+1}^d + \frac{(2-\beta)\left(4\beta - 2n\beta - m\beta^2 + 4\right)}{4(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}_t^r, 1] \end{cases} \tag{3.27}$$

where $\bar{\tau}_t^r$ is defined in (3.23)

3.7.1.2 The equilibrium law of motion of tax rates

The equilibrium law of motion of τ_t^r and τ_t^d can be derived in two steps.

Firstly, we know that if $\tau_t^r \in [0, \bar{\tau}_t^r]$ or equivalently $\tau_t^d \in \left[0, \bar{\tau}_t^r - n + a_t^d\right]$, then $i_t \in (\bar{\imath}_t, 1+\beta]$, $\tau_t^d = 1 - n + a_t^d$ and $\tau_t^r = 1$.

Secondly, if $\tau_t^r \in (\bar{\tau}_t^r, 1]$ or equivalently $\tau_t^d \in \left(\bar{\tau}_t^r - n + a_t^d, 1 - n + a_t^d\right]$, then $i_t \in [0, \bar{\imath}_t]$. From the citizens' decision rule of investment, we have

$$i_t = -\frac{(2-\beta)\,\tau_t^r}{2} + \frac{\beta\,(2-\beta)}{4}a_{t+1}^d + \frac{(2-\beta)\,(4\beta - 2n\beta - m\beta^2 + 4)}{4\,(\beta+2)} \tag{3.28}$$

From the incumbent's decision rule about tax rate, we have

$$\tau_{t+1}^d = \frac{1}{2-\beta}i_t + \frac{1}{2}a_{t+1}^d + \frac{\frac{\beta m}{2} + 1 + \beta - n - n\beta}{2+\beta} \tag{3.29}$$

Plug (3.28) in (3.29) and rearrange, we have

$$\tau_{t+1}^d = -\frac{\tau_t^r}{2} + \frac{\beta+2}{4}a_{t+1}^d + \frac{8\beta - 4n + 2m\beta - 6n\beta - m\beta^2 + 8}{4(\beta+2)} \tag{3.30}$$

Plug $\tau_t^r = \tau_t^d + n - a_t^d$ in (3.30), we get the equilibrium law of motion of τ_t^d in this case

$$\tau_{t+1}^d = -\frac{\tau_t^d + n - a_t^d}{2} + \frac{\beta+2}{4}a_{t+1}^d + \frac{8\beta - 4n + 2m\beta - 6n\beta - m\beta^2 + 8}{4(\beta+2)}$$

The equilibrium law of motion τ_t^r can be derived by adding $n - a_{t+1}^d$ on both sides of (3.30):

$$\begin{aligned} \tau_{t+1}^r &= \tau_{t+1}^d + n - a_{t+1}^d \\ &= -\frac{\tau_t^r}{2} + \frac{\beta-2}{4}a_{t+1}^d + \frac{(4n + 8\beta + 2m\beta - 2n\beta - m\beta^2 + 8)}{4(\beta+2)} \end{aligned}$$

Now we can conclude that the equilibrium law of motion of τ_t^d is

$$\tau_{t+1}^d = \begin{cases} 1 - n + a_{t+1}^d, & if \quad \tau_t^d \in \left[0, \bar{\tau}_t^d\right] \\ -\frac{\tau_t^d + n - a_t^d}{2} + \frac{\beta+2}{4}a_{t+1}^d + \frac{8\beta - 4n + 2m\beta - 6n\beta - m\beta^2 + 8}{4(\beta+2)}, & if \quad \tau_t^d \in \left(\bar{\tau}_t^d, 1 - n + a_t^d\right] \end{cases} \tag{3.31}$$

where

$$\bar{\tau}_t^d \equiv \bar{\tau}_t^r - n + a_t^d$$

and the equilibrium law of motion of τ_{t+1}^r is

$$\tau_{t+1}^r = \begin{cases} 1, & if \quad \tau_t^r \in [0, \bar{\tau}_t^r] \\ -\frac{\tau_t^r}{2} + \frac{\beta-2}{4}a_{t+1}^d + \frac{\left(4n + 8\beta + 2m\beta - 2n\beta - m\beta^2 + 8\right)}{4(\beta+2)}, & if \quad \tau_t^a \in (\bar{\tau}_t^r, 1] \end{cases} \tag{3.32}$$

3.7.1.3 The dynamics of the economy

From the incumbent's decision about the successor's strength, we know that for any $a_0^d \in [0, m]$ and $i_{-1} \in [0, 1+\beta]$, $a_t^d = m$ for all $t \geq 1$. Replacing a_t^d and a_{t+1}^d with m in (3.20), (3.27), (3.31) and (3.32) respectively, we get the decision rules of the incumbent and the citizens, and the equilibrium laws of motion of τ_t^d and τ_t^r of the equilibrium:

$$T\left(a_t^d, i_{t-1}\right) = \begin{cases} \frac{1}{2-\beta} i_{t-1} + \frac{\beta+1}{\beta+2}\left(m - n + 1\right), & if \quad i_{t-1} \in [0, \bar{\imath}] \\ 1 - n + m, & if \quad i_{t-1} \in (\bar{\imath}, 1+\beta] \end{cases} \tag{3.33}$$

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = \begin{cases} 1 - \tau_t^r, & if \quad \tau_t^r \in [0, \bar{\tau}^r] \\ -\frac{(2-\beta)\tau_t^a}{2} + \frac{\beta(2-\beta)}{4} m + \frac{(2-\beta)\left(4\beta - 2n\beta - m\beta^2 + 4\right)}{4(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}^r, 1] \end{cases} \tag{3.34}$$

$$\tau_{t+1}^d = \begin{cases} 1 - n + m, & if \quad \tau_t^d \in [0, \bar{\tau}^r - n + m] \\ -\frac{\tau_t^d + n - m}{2} + \frac{\beta+2}{4} m + \frac{8\beta - 4n + 2m\beta - 6n\beta - m\beta^2 + 8}{4(\beta+2)}, & if \quad \tau_t^d \in (\bar{\tau}^r - n + m, 1 - n + m] \end{cases} \tag{3.35}$$

and

$$\tau_{t+1}^r = \begin{cases} 1, & if \quad \tau_t^r \in [0, \bar{\tau}^r] \\ -\frac{\tau_t^r}{2} + \frac{\beta-2}{4} m + \frac{\left(4n + 8\beta + 2m\beta - 2n\beta - m\beta^2 + 8\right)}{4(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}^r, 1] \end{cases} \tag{3.36}$$

where $\bar{\imath}$ and $\bar{\tau}^r$ are obtained by replacing a_t^d and a_{t+1}^d with m in (3.21) and (3.23), respectively:

$$\bar{\imath} = \frac{2-\beta}{\beta+2}\left(1 - n + m\right)$$

$$\bar{\tau}^r = \frac{\beta-2}{2} m + \frac{\left(4n + 4\beta + 2m\beta - 2n\beta - m\beta^2\right)}{2\left(\beta+2\right)}$$

From section 3.7.1.1, we know that $\tau_t^r > \bar{\tau}_t^r$ for all t, where $\bar{\tau}_t^r$ is the threshold level of real tax rate at period t below which the next period real

tax rate τ_{t+1}^r achieves the corner solution of one. This result can help to characterize the evolution of τ_t^r, which can be done by three steps.

Firstly, if $i_{-1} \in [0, \bar{\imath}]$, then $\bar{\tau}^r < \tau_0^r < 1$. Since $\tau_0^r > \bar{\tau}^r$, $\tau_1^r < 1$. Since $\tau_1^r > \bar{\tau}^r$, then $\tau_2^r < 1$. If we do this recurssively, we can know that for $i_{-1} \in [0, \bar{\imath}]$, $\tau_t^r < 1$ for all $t \geq 0$.

Secondly, if $i_{-1} \in (\bar{\imath}, 1+\beta]$, then $\tau_0^r = 1$. Since $\tau_0^r > \bar{\tau}^r$, $\tau_1^r < 1$. Since $\tau_1^r > \bar{\tau}^r$, then $\tau_2^r < 1$. If we do this recurssively, we can know that for $i_{-1} \in (\bar{\imath}, 1+\beta]$, $\tau_0^r = 1$ and $\tau_t^r < 1$ for all $t > 0$.

Thirdly, since the slope of the equilibrium law of motion of τ_t^r is $-\frac{1}{2}$, which is negative and smaller than one in absolute value, this means τ_t^r converges in an oscillatory pattern to the steady state.

With exactly the same three steps, we can get the the evolution of τ_t^d : *(i)* If $i_{-1} \in [0, \bar{\imath}]$, then $\tau_0^d = 1 - n + a_t^d$ and τ_t^d converges in an oscillatory pattern to the steady state with $\tau_t^d < 1$ for all $t \geq 1$. *(ii)* If $i_{-1} \in (\bar{\imath}, 1+\beta]$, then τ_t^d converges in an oscillatory pattern to the steady state with $\tau_t^d < 1$ for all $t \geq 0$.

The steady state of τ_t^d can be derived by setting $\tau_{t+1}^d = \tau_t^d = \tau_{ss}^d$ in the second part of (3.35) and solving the corresponding τ_{ss}^d :

$$\tau_{ss}^d = \frac{1}{3\beta + 6}\left(4m - 4n + 4\beta + 4m\beta - 4n\beta + 4\right) \tag{3.37}$$

The steady state of τ_t^r can be derived by adding $n - m$ on both sides of (3.37):

$$\begin{aligned} \tau_{ss}^r &= \tau_{ss}^d + n - m \\ &= \frac{1}{3\left(\beta + 2\right)}\left(2n - 2m + 4\beta + m\beta - n\beta + 4\right) \end{aligned}$$

The steady state of investment can be derived by plugging τ_{ss}^r in the

second part of (3.34):

$$i_{ss} = \frac{1}{3(\beta+2)}\left(-\beta^2+\beta+2\right)(m-n+1)$$

3.7.2 Proof of Proposition 2

3.7.2.1 The decision rules

Like in the proof of Proposition 1, I will also use the "guess and verify" strategy to derive the incumbent's decision rules of the successor's strength and the tax rate, and the citizens' decision rule of investment.

Start by guessing $\tau_t^d = Di_{t-1}+E\alpha_t^d+F$ for all t and ignoring the constraint that $\tau_t^d \in \left[0, 1-n+a_t^d\right]$. Given this guess, we have

$$\tau_{t+1}^d = Di_t + E\alpha_{t+1}^d + F$$

and

$$\begin{aligned}\tau_{t+1}^r &= \tau_{t+1}^d + n - \alpha_{t+1}^d \\ &= Di_t + (E-1)\alpha_{t+1}^d + F + n\end{aligned}$$

Plug the expression of τ_{t+1}^r in (3.2), we have

$$\begin{aligned}i_t &= (1-\tau_t^r) + \beta\left(1-\tau_{t+1}^r\right) \\ &= 1-\tau_t^d - n + \alpha_t^d + \beta\left(1-Di_t-(E-1)\alpha_{t+1}^d - F - n\right) \quad (3.38)\end{aligned}$$

Solve for i_t in (3.38), we have

$$i_t = \frac{1-\tau_t^d - n + \alpha_t^d + \beta\left(1-(E-1)\alpha_{t+1}^d - F - n\right)}{1+\beta D} \quad (3.39)$$

Plug (3.39) in the indirect utility function of the old incumbent and rearrange,

we have

$$V^{od} = \tau_t^d \left(i_{t-1} + \frac{1 - \tau_t^d - n + \alpha_t^d + \beta\left(1 - F - n\right)}{1 + \beta D} + \frac{\beta\left(1 - E\right)\alpha_{t+1}^d}{1 + \beta D} \right) \tag{3.40}$$

As we can see from (3.40), given the guess about the expression of τ_t^d, the incumbent's decisions of the successor's strength and the tax rate can be separate now. That is, if $\frac{\beta(1-E)}{1+\beta D} > 0$, for any i_{t-1}, τ_t^d,and α_t^d, the incumbent will firstly choose $\alpha_{t+1}^d = (1-d)\,\alpha_t^d$, since this maximizes his tax base; If $\frac{\beta(1-E)}{1+\beta D} \leq 0$, the incumbent will choose $\alpha_{t+1}^d = 0$, since this maximizes his tax base. After choosing the strength of the successor, the incumbent just chooses a τ_t^d to ensure his tax revenue is on the peak of Laffer curve.

My following strategy is to suppose $\frac{\beta(1-E)}{1+\beta D} > 0$, plug in $\alpha_{t+1}^d = (1-d)\,\alpha_t^d$ in (3.40), get a solution candidate $\{D_1, E_1, F_1\}$ of $\{D, E, F\}$, and then to verify in this case, $\frac{\beta(1-E_1)}{1+\beta D_1} > 0$.Then I suppose $\frac{\beta(1-E)}{1+\beta D} \leq 0$ and plug in $\alpha_{t+1}^d = 0$ in (3.40), get a solution candidate $\{D_2, E_2, F_2\}$ of $\{D, E, F\}$ and then to verify in this case, $\frac{\beta(1-E_2)}{1+\beta D_2} \leq 0$ does not hold.

Suppose $\frac{\beta(1-E)}{1+\beta D} > 0$, then

$$\alpha_{t+1}^d = (1-d)\,\alpha_t^d \tag{3.41}$$

Plug (3.41) in (3.40), we have

$$V^{od} = \frac{\tau_t^d}{D_1\beta + 1} \left(\begin{array}{c} \left(1 + D_1\beta\right) i_{t-1} - \tau_t^d \\ + \left(1 + \beta\left(1 - E_1\right)\left(1 - d\right)\right)\alpha_t^d + 1 + \beta - n - F_1\beta - n\beta \end{array} \right)$$

First order condition with respect to τ_t^d , we have

$$\tau_t^d = \frac{\left(1 + D_1\beta\right) i_{t-1} + \left(1 + \beta\left(1 - E_1\right)\left(1 - d\right)\right)\alpha_t^d + 1 + \beta - n - F_1\beta - n\beta}{2}$$

Since we have guessed

$$\tau_t^d = Di_{t-1} + E\alpha_t^d + F$$

then the following equality must hold for all t

$$\begin{aligned} & \frac{\left(1 + D_1\beta\right) i_{t-1} + \left(1 + \beta\left(1 - E_1\right)\left(1 - d\right)\right) \alpha_t^d + 1 + \beta - n - F_1\beta - n\beta}{2} \\ = \quad & D_1 i_{t-1} + E_1\alpha_t^d + F_1 \end{aligned} \tag{3.42}$$

If (3.42) holds for all t, then the following equation system must hold

$$\begin{cases} \frac{1+D_1\beta}{2} = D_1 \\ \frac{1+\beta(1-E_1)(1-d)}{2} = E_1 \\ \frac{1+\beta-n-F_1\beta-n\beta}{2} = F_1 \end{cases}$$

Solve the equation system, we get

$$\begin{cases} D_1 = \frac{1}{2-\beta} \\ E_1 = \frac{1+\beta(1-d)}{2+\beta(1-d)} \\ F_1 = \frac{1+\beta-n-n\beta}{2+\beta} \end{cases}$$

In this case, $\frac{\beta(1-E_1)}{1+\beta D_1} = \frac{\beta(2-\beta)}{2\beta(1-d)+4} > 0$ for $\beta \in (0,1)$ and $d \in (0,1)$. Therefore, $\{D_1, E_1, F_1\}$ is a solution of $\{D, E, F\}$.

Suppose $\frac{\beta(1-E)}{1+\beta D} \leq 0$, then $\alpha_{t+1}^d = 0$. Performing exactly the same steps above as in deriving $\{D_1, E_1, F_1\}$, we get

$$\begin{cases} D_2 = \frac{1}{2-\beta} \\ E_2 = \frac{1}{2} \\ F_2 = \frac{\beta-n-n\beta+1}{2+\beta} \end{cases}$$

In this case, $\frac{\beta(1-E_2)}{1+\beta D_2} = \frac{1}{2} - \frac{1}{4}\beta > 0$ for $\beta \in (0,1)$. This contradicts our guess that $\frac{\beta(1-E_2)}{1+\beta D_2} \leq 0$. Therefore, $\{D_2, E_2, F_2\}$ is not the solution of $\{D, E, F\}$ and

we conclude that

$$\begin{cases} D = D_1 = \frac{1}{2-\beta} \\ E = E_1 = \frac{1+\beta(1-d)}{2+\beta(1-d)} \\ F = F_1 = \frac{1+\beta-n-n\beta}{2+\beta} \end{cases}$$

Now consider the constraint $\tau_t^d \in \left[0, 1+n-a_t^d\right]$. This can be done in two steps. Firstly, consider the constraint

$$\tau_t^d \geq 0 \tag{3.43}$$

With the solution of $\{D, E, F\}$, (3.43) can be rewritten as

$$\frac{1}{2-\beta} i_{t-1} + \frac{1+\beta(1-d)}{2+\beta(1-d)} a_t^d + \frac{1+\beta-n-n\beta}{2+\beta} \geq 0 \tag{3.44}$$

Simplifying (3.44), we get.

$$n \leq \frac{2+\beta}{(2-\beta)(1+\beta)} i_{t-1} + \frac{(1+\beta(1-d))(2+\beta)}{(2+\beta(1-d))((1+\beta))} a_t^d + 1 \tag{3.45}$$

In order for (3.45) to hold for all $i_{t-1} \in [0, 1+\beta]$ and $a_t^d \in [0, m]$, (3.345) must hold when evaluating at $i_{t-1} = 0$ and $a_t^d = 0$ since the RHS of (3.45) achieves its minimum in this case. With this findings, the necessary and sufficient condition for (3.45) to hold is

$$n \leq 1 \tag{3.46}$$

Secondly, consider the constraint

$$\tau_t^d \leq 1 - n + a_t^d \tag{3.47}$$

With the solution of $\{D, E, F\}$, (3.12) can be rewritten as

$$\frac{1}{2-\beta} i_{t-1} + \frac{1+\beta(1-d)}{2+\beta(1-d)} a_t^d + \frac{1+\beta-n-n\beta}{2+\beta} \leq 1 - n + a_t^d \tag{3.48}$$

Simplifying (3.48), we get

$$n \leq -\frac{\beta+2}{2-\beta} i_{t-1} - \frac{\beta+2}{2+\beta(1-d)} a_t^d + 1 \tag{3.49}$$

For given a_t^d, in order for (3.49) to hold for all $i_{t-1} \in [0, 1+\beta]$, (3.49) must hold when evaluating at $i_{t-1} = 1+\beta$ because $-\frac{2+\beta}{2-\beta} < 0$ for $\beta \in (0,1)$. Evaluating (3.49) at $i_{t-1} = 1+\beta$, we get

$$n \leq -\frac{\beta}{2-\beta}(\beta+4) - \frac{\beta+2}{2+\beta(1-d)} a_t^d \tag{3.50}$$

The RHS of (3.50) must be negative because the term $-\frac{\beta}{2-\beta}(\beta+4)$ is negative for $\beta \in (0,1)$ and the term $-\frac{\beta+2}{2+\beta(1-d)} a_t^d$ is larger or equal to zero for $a_t^d \in [0, m]$. The LHS of (3.50) must be positive by assumption. Therefore, there is a contradiction and (3.50) can not hold for all $i_{t-1} \in [0, 1+\beta]$. This means for given a_t^d, τ_t^d gets a corner solution with

$$\tau_t^d = 1 - n + a_t^d$$

when i_{t-1} is larger than some threshold value $\bar{\imath}_{t-1}$, which can be derived by equalizing the two sides of (3.48), with

$$\bar{\imath}_{t-1} = (2-\beta)\left(\frac{(1-n)}{2+\beta} + \frac{a_t^d}{2+\beta(1-d)}\right) \tag{3.51}$$

From (3.51), we can easily see that $\bar{\imath}_{t-1} > 0$ because $\beta \in (0,1)$, $n < 1$ and $a_t^d \in [0, m]$ by assumption.

At this moment, we can *conjecture* that if $n < 1$ and all the incumbents choose a sufficient weak successor, the incumbent ruler's decision rule about

successor is

$$A\left(a_t^d, i_{t-1}\right) = (1-d)\,\alpha_t^d$$

and the decision rule about tax rate is

$$T\left(a_t^d, i_{t-1}\right) = \begin{cases} \frac{1}{2-\beta} i_{t-1} + \frac{1+\beta(1-d)}{2+\beta(1-d)} a_t^d + \frac{1+\beta-n-n\beta}{2+\beta}, & if \quad i_{t-1} \in [0, \bar{\imath}_{t-1}] \\ 1-n+a_t^d, & if \quad i_{t-1} \in (\bar{\imath}_{t-1}, 1+\beta] \end{cases} \tag{3.52}$$

With the conjecture in (3.52), the citizens' decision rule of investment can be derived in two steps.

Firstly, if $0 \leq i_t \leq \bar{\imath}_t$ due to a high $\tau_t^r \in (\bar{\tau}_t^r, 1]$, where $\bar{\imath}_t$ is derived by moving one period forward in (3.51):

$$\bar{\imath}_t = (2-\beta)\left(\frac{(1-n)}{2+\beta} + \frac{a_{t+1}^d}{2+\beta\,(1-d)}\right) \tag{3.53}$$

and citizens' decision rule of investment in this case can be derived by plugging in the values of D, E and F in (3.39):

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = -\frac{(2-\beta)\,\tau_t^r}{2} + \frac{\beta\,(2-\beta)\,\alpha_{t+1}^d}{2\,(2+\beta\,(1-d))} + \frac{(2-\beta)\,(2\beta-n\beta+2)}{2\,(\beta+2)} \tag{3.54}$$

The threshold level $\bar{\tau}_t^r$ can be derived by plugging the (3.53) into (3.54) for investment and solving for the corresponding actural tax rate with

$$\bar{\tau}_t^r = \frac{(\beta-2)\,\alpha_{t+1}^d}{(2+\beta\,(1-d))} + \frac{1}{\beta+2}\,(2n+2\beta-n\beta) \tag{3.55}$$

Secondly, if $\bar{\imath}_t < i_t \leq 1+\beta$ due to $\tau_t^r \in [0, \bar{\tau}_t^r]$, then according to the conjecture of incumbent's rule of tax rate in (3.52),

$$\tau_{t+1}^d = 1-n+a_t^d$$

and

$$\tau_{t+1}^r = 1$$

The citizens' decision rule of investment in this case can be derived by plugging $\tau_{t+1}^r = 1$ in (3.2) with

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = 1 - \tau_t^r \tag{3.56}$$

From (3.54) and (3.56), we can see the citizens' decision rule of investment is stepwise. Due to this, there can be a problem with the *conjecture* in (3.52). That is, if the real tax rate at period t is smaller than $\bar{\tau}_t^r$ due to a low i_{t-1}, then expecting the next period real rate will be a corner solution that equals to one, the citizens' decision rule will be the expression in (3.56). If we plug (3.56) in the indirect utility function of the old incumbent and redo the guessing and verifying, we can get another decision rule about tax rate of the incumbent, which will be different than what we get in the first part of (3.52). This will make the problem complictated.

In the following step, we will figure out the condition under which $\tau_t^r > \bar{\tau}_t^r$ for all t. This can greatly simplify the anylysis.

From the first part of (3.52), we can see that for given α_t^d, τ_t^d and τ_t^r achieve their minimum when $i_{t-1} = 0$. If we can show the minimum of τ_t^r, which is denoted as $\tau_t^{r\,\min}$, is higher than $\bar{\tau}_t^r$, then we can conclude that τ_t^r will always be higher than $\bar{\tau}_t^r$. $\tau_t^{r\,\min}$ can be solved by plugging $i_{t-1} = 0$ into the first part of (3.52) and adding $n - a_t^d$ on both sides:

$$\tau_t^{r\,\min} = -\frac{1}{2 + \beta\,(1-d)} a_t^d + \frac{1}{\beta + 2}\,(n + \beta + 1) \tag{3.57}$$

By (3.55) and (3.57), the difference between $\tau_t^{r\,\min}$ and $\bar{\tau}_t^r$ is

$$\tau_t^{r\,\min} - \bar{\tau}_t^r = -\frac{1}{2 + \beta\,(1-d)} a_t^d - \frac{(\beta - 2)\,\alpha_{t+1}^d}{(2 + \beta\,(1-d))} + \frac{1-\beta}{\beta + 2}\,(1 - n) \tag{3.58}$$

From our conjecture about the incumbent's decision rule about sucessor's strength, we know $a_{t+1}^d = (1-d)\, a_t^d$ for all $t \geq 0$. Plug $a_{t+1}^d = (1-d)\, a_t^d$ into (3.58), we get

$$\tau_t^{r\min} - \bar{\tau}_t^r = \frac{(2-\beta)(1-d)-1}{(2+\beta(1-d))} a_t^d + \frac{1-\beta}{\beta+2}(1-n) \tag{3.59}$$

Examing (3.59), we can see that if $(2-\beta)(1-d)-1 > 0$ or equivalently, $d < \frac{1-\beta}{2-\beta}$, then $\tau_t^{r\min} - \bar{\tau}_t^r$ must be positive. This means if $d < \frac{1-\beta}{2-\beta}$, then $\tau_t^r > \bar{\tau}_t^r$ for all t and we can conclude that the incumbent's decision rules are

$$A\left(a_t^d, i_{t-1}\right) = (1-d)\, \alpha_t^d$$

and

$$T\left(a_t^d, i_{t-1}\right) = \begin{cases} \frac{1}{2-\beta} i_{t-1} + \frac{1+\beta(1-d)}{2+\beta(1-d)} a_t^d + \frac{1+\beta-n-n\beta}{2+\beta}, & if \quad i_{t-1} \in [0, \bar{\imath}_{t-1}] \\ 1-n+a_t^d, & if \quad i_{t-1} \in (\bar{\imath}_{t-1}, 1+\beta] \end{cases}$$

where

$$\bar{\imath}_{t-1} = (2-\beta)\left(\frac{(1-n)}{2+\beta} + \frac{a_t^d}{2+\beta(1-d)}\right)$$

Given the ruler's decision rules, the citizens' decision rule of investment is

$$I\left(\alpha_{t+1}^d, \tau_t^r\right) = \begin{cases} 1-\tau_t^r, & if \quad \tau_t^r \in [0, \bar{\tau}_t^r] \\ -\frac{(2-\beta)\tau_t^r}{2} + \frac{\beta(2-\beta)\alpha_{t+1}^d}{2(2+\beta(1-d))} + \frac{(2-\beta)(2\beta-n\beta+2)}{2(\beta+2)}, & if \quad \tau_t^r \in (\bar{\tau}_t^r, 1] \end{cases}$$

where

$$\bar{\tau}_t^r = \frac{(\beta-2)\,\alpha_{t+1}^d}{(2+\beta(1-d))} + \frac{1}{\beta+2}(2n+2\beta-n\beta)$$

3.7.2.2 The equilibrium law of motion of tax rates

The equilibrium law of motion of τ_t^r and τ_t^d can be derived in two steps.

Firstly, we know that if $\tau_t^r \in [0, \bar{\tau}_t^r]$ or equivalently $\tau_t^d \in \left[0, \bar{\tau}_t^r - n + a_t^d\right]$,

then $i_t \in (\bar{\imath}_t, 1+\beta]$, $\tau^d_{t+1} = 1-n+a^d_{t+1}$ and $\tau^r_{t+1} = 1$.

Secondly, if $\tau^r_t \in (\bar{\tau}^r_t, 1]$ or equivalently $\tau^d_t \in \left(\bar{\tau}^r_t - n + a^d_t, 1-n+a^d_t\right]$, then $i_t \in [0, \bar{\imath}_t]$. From the citizens' decision rule of investment, we have

$$i_t = -\frac{(2-\beta)\,\tau^r_t}{2} + \frac{\beta\,(2-\beta)\,\alpha^d_{t+1}}{2\,(2+\beta\,(1-d))} + \frac{(2-\beta)\,(2\beta - n\beta + 2)}{2\,(\beta+2)} \tag{3.60}$$

From the incumbent's decision rule about tax rate, we have

$$\tau^d_{t+1} = \frac{1}{2-\beta} i_t + \frac{1+\beta\,(1-d)}{2+\beta\,(1-d)} a^d_{t+1} + \frac{1+\beta-n-n\beta}{2+\beta} \tag{3.61}$$

Plug (3.60) in (3.61) and rearrange, we have

$$\tau^d_{t+1} = -\frac{\tau^r_t}{2} + \left[\frac{2+2\beta\,(1-d)+\beta}{2\,(2+\beta\,(1-d))}\right] \alpha^d_{t+1} + \frac{1}{2\,(\beta+2)}\,(4\beta - 2n - 3n\beta + 4) \tag{3.62}$$

Plug $\tau^r_t = \tau^d_t + n - a^d_t$ in (3.62), we get the equilibrium law of motion of τ^d_t in this case

$$\tau^d_{t+1} = -\frac{\tau^d_t + n - a^d_t}{2} + \left[\frac{2+2\beta\,(1-d)+\beta}{2\,(2+\beta\,(1-d))}\right] \alpha^d_{t+1} + \frac{1}{2\,(\beta+2)}\,(4\beta - 2n - 3n\beta + 4) \tag{3.63}$$

The equilibrium law of motion τ^r_t can be derived by adding $n - a^d_{t+1}$ on both sides of (3.63):

$$\tau^r_{t+1} = -\frac{\tau^r_t}{2} - \left[\frac{2-\beta}{2\,(2+\beta\,(1-d))}\right] \alpha^d_{t+1} + \frac{1}{2\,(\beta+2)}\,(2n + 4\beta - n\beta + 4) \tag{3.64}$$

Now we can conclude that the equilibrium law of motion of τ^d_t is

$$\tau^d_{t+1} = \begin{cases} 1-n+a^d_t, & if \quad \tau^d_t \in \left[0, \bar{\tau}^d_t\right] \\ -\frac{\tau^d_t + n - a^d_t}{2} + \left[\frac{2+2\beta(1-d)+\beta}{2(2+\beta(1-d))}\right] \alpha^d_{t+1} + \frac{4\beta-2n-3n\beta+4}{2(\beta+2)}, & if \quad \tau^d_t \in \left(\bar{\tau}^d_t, 1-n+a^d_t\right] \end{cases} \tag{3.65}$$

where

$$\bar{\tau}_t^d \equiv \bar{\tau}_t^r - n + a_t^d$$

and the equilibrium law of motion of τ_{t+1}^r is

$$\tau_{t+1}^r = \begin{cases} 1, & if \quad \tau_t^r \in [0, \bar{\tau}_t^r] \\ -\frac{\tau_t^r}{2} - \left[\frac{2-\beta}{2(2+\beta(1-d))}\right] \alpha_{t+1}^d + \frac{1}{2(\beta+2)} \left(2n + 4\beta - n\beta + 4\right), & if \quad \tau_t^r \in (\bar{\tau}_t^r, 1] \end{cases} \tag{3.66}$$

3.7.2.3 The dynamics of the economy

From section 3.7.2.1, we know that $\tau_t^r > \bar{\tau}_t^r$ for all t, where $\bar{\tau}_t^r$ is the threshold level of real tax rate at period t below which the next period real tax rate τ_{t+1}^r achieves the corner solution of one. This result can help to characterize the evolution of τ_t^r, which can be done by three steps.

Firstly, if $i_{-1} \in [0, \bar{i}]$, then $\bar{\tau}^r < \tau_0^r < 1$. Since $\tau_0^r > \bar{\tau}^r$, $\tau_1^r < 1$. Since $\tau_1^r > \bar{\tau}^r$, then $\tau_2^r < 1$. If we do this recurssively, we can know that for $i_{-1} \in [0, \bar{i}]$, $\tau_t^r < 1$ for all $t \geq 0$.

Secondly, if $i_{-1} \in (\bar{i}, 1 + \beta]$, then $\tau_0^r = 1$. Since $\tau_0^r > \bar{\tau}^r$, $\tau_1^r < 1$. Since $\tau_1^r > \bar{\tau}^r$, then $\tau_2^r < 1$. If we do this recurssively, we can know that for $i_{-1} \in (\bar{i}, 1 + \beta]$, $\tau_0^r = 1$ and $\tau_t^r < 1$ for all $t > 0$.

Thirdly, since the slope of the equilibrium law of motion of τ_t^r is $-\frac{1}{2}$, which is negative and smaller than one in absolute value, this means τ_t^r converges in an oscillatory pattern to the steady state.

With exactly the same three steps, we can get the the evolution of τ_t^d : *(i)* If $i_{-1} \in [0, \bar{i}]$, then $\tau_0^d = 1 - n + a_t^d$ and τ_t^d converges in an oscillatory pattern to the steady state with $\tau_t^d < 1$ for all $t \geq 1$. *(ii)* If $i_{-1} \in (\bar{i}, 1 + \beta]$, then τ_t^d converges in an oscillatory pattern to the steady state with $\tau_t^d < 1$ for all $t \geq 0$.

The steady state of the model economy can be solved by the following steps:

Firstly, since the incumbent's decision rule about successor's strength is

$$A\left(a_t^d, i_{t-1}\right) = (1-d)\,\alpha_t^d,$$

then when $t \to \infty$, $\alpha_t^d \to 0$.

Secondly, the steady state of τ_t^d can be derived by setting $\tau_{t+1}^d = \tau_t^d = \tau_{ss}^d$ and $\alpha_t^d = \alpha_{t+1}^d = 0$ in the second part of (3.65) and solving the corresponding τ_{ss}^d :

$$\tau_{ss}^d = \frac{4\,(\beta+1)\,(1-n)}{3\,(\beta+2)}$$

Thirdly, the steady state of τ_t^r can be derived by setting $\tau_{t+1}^r = \tau_t^r = \tau_{ss}^r$ and $\alpha_t^d = \alpha_{t+1}^d = 0$ in the second part of (3.66) and solving the corresponding τ_{ss}^r :

$$\tau_{ss}^r = \frac{1}{3\,(\beta+2)}\,(2n + 4\beta - n\beta + 4) \tag{3.67}$$

The steady state of investment can be derived by plugging (3.67) and $\alpha_t^d = \alpha_{t+1}^d = 0$ in the second part of (3.34):

$$i_{ss} = \frac{1}{3\,(\beta+2)}\left(-\beta^2 + \beta + 2\right)(1-n)$$

3.7.3 Proof of Proposition 3

If the incumbent at period t does not choose a sufficiently weak successor, obviously, he will choose a successor with strength

$$\alpha_{t+1}^d \in \left((1-d)\,a_t^d, \min\left\{(1+d)\,a_t^d, m\right\}\right]$$

because if he chooses a successor with $\alpha_{t+1}^d > (1+d)\,a_t^d$, the incumbent will lose for sure.

As we already know, given the timing of the game, the citizens' investment rule in this case is the same as in the case where all the incumbents

choose sufficiently weak successor. From Proposition 4, we know the citizens' investment rule is

$$I\left(\alpha_{t+1}^{d},\tau_{t}^{r}\right)=\begin{cases}1-\tau_{t}^{r}, & if \quad \tau_{t}^{r}\in[0,\bar{\tau}_{t}^{r}]\\ -\frac{(2-\beta)\tau_{t}^{r}}{2}+\frac{\beta(2-\beta)\alpha_{t+1}^{d}}{2(2+\beta(1-d))}+\frac{(2-\beta)(2\beta-n\beta+2)}{2(\beta+2)}, & if \quad \tau_{t}^{r}\in(\bar{\tau}_{t}^{r},1]\end{cases} \tag{3.68}$$

where

$$\bar{\tau}_{t}^{r}=\frac{(\beta-2)\,\alpha_{t+1}^{d}}{(2+\beta\,(1-d))}+\frac{1}{\beta+2}\,(2n+2\beta-n\beta)$$

Also, since there is only one period deviation at period t, all the future rulers will choose a sufficiently weak successor. This means at period $t+1$,

$$\tau_{t+1}^{d}=\begin{cases}\frac{1}{2-\beta}i_{t}+\frac{1}{2}a_{t+1}^{d}+\frac{\frac{\beta m}{2}+1+\beta-n-n\beta}{2+\beta}, & if \quad i_{t}\in[0,\bar{i}_{t}]\\ 1+n-a_{t+1}^{d}, & if \quad i_{t}\in(\bar{i}_{t},1+\beta]\end{cases} \tag{3.69}$$

where (3.69) is derived by moving one period forward in the incumbent's decision rule about tax rate in Proposition 4. Note that since in this case, the incumbent may choose a successor with strength higher than $(1-d)\,a_{t}^{d}$, this implies i_t can be larger than in the case where the successor is sufficiently weak as i_t increases when α_{t+1}^{d} goes up (see the second part of (3.68)), and τ_{t}^{r} can be higher than $\bar{\tau}_{t}^{r}$. This can make τ_{t}^{r} have a corner solution of one. Therefore, unlike in the case where all the incumbents choose a sufficiently weak successor and $\tau_{t}^{r}>\bar{\tau}_{t}^{r}$, given $d<\frac{1-\beta}{2-\beta}$, there can be the following two possibilities: *(i)* $i_{t}\in[0,\bar{i}_{t}]$ for all $\alpha_{t+1}^{d}\in\left((1-d)\,a_{t}^{d},\min\left\{(1+d)\,a_{t}^{d},m\right\}\right]$. This means $\tau_{t+1}^{r}<1$.*(ii)* $i_{t}\in[\bar{i}_{t},1+\beta]$ for some $\alpha_{t+1}^{d}\in\left((1-d)\,a_{t}^{d},\min\left\{(1+d)\,a_{t}^{d},m\right\}\right]$.

3.7.3.1 $i_{t}\in[0,\bar{i}_{t}]$ for all $\alpha_{t+1}^{d}\in\left((1-d)\,a_{t}^{d},\min\left\{(1+d)\,a_{t}^{d},m\right\}\right]$

In this case,

$$\tau_{t+1}^{r}<1$$

and

$$\tau_{t+1}^{d}=\frac{1}{2-\beta}i_{t}+\frac{1}{2}a_{t+1}^{d}+\frac{\frac{\beta m}{2}+1+\beta-n-n\beta}{2+\beta} \tag{3.70}$$

Plug (3.70) in the indirect utility function of the incumbent, we have

$$V_{nsw}^{od}=\frac{1}{2}\tau_{t}^{d}\left(\begin{array}{c} i_{t-1}-\frac{(2-\beta)\tau_{t}^{d}}{2}+\frac{(2-\beta)a_{t}^{d}}{2}+\frac{(2-\beta)\alpha_{t+1}^{d}}{2(2+\beta(1-d))} \\ -\frac{1}{\beta+2}\left(n-1\right)\left(-\beta^{2}+\beta+2\right) \end{array}\right)+\frac{1}{2}\Psi \tag{3.71}$$

From (3.71), we can see the ruler will choose

$$\alpha_{t+1}^{d}=\min\left\{\left(1+d\right)a_{t}^{d},m\right\} \tag{3.72}$$

since this maximizes his tax base.

Plug (3.72) in (3.71), we get

$$V_{nsw}^{od}=\frac{1}{2}\tau_{t}^{d}\left(i_{t-1}-\frac{\left(2-\beta\right)\tau_{t}^{d}}{2}+N\right)+\frac{1}{2}\Psi \tag{3.73}$$

where

$$N\equiv\frac{\left(2-\beta\right)a_{t}^{d}}{2}+\frac{\left(2-\beta\right)\min\left\{\left(1+d\right)a_{t}^{d},m\right\}}{2\left(2+\beta\left(1-d\right)\right)}-\frac{1}{\beta+2}\left(n-1\right)\left(-\beta^{2}+\beta+2\right)$$

Taking the first order condition with respect to τ_{t}^{d} in (3.73), we get

$$\tau_{t}^{d}=\frac{i_{t-1}+N}{2-\beta}$$

and

$$V_{nsw}^{od}=\frac{\left(i_{t-1}+N\right)^{2}}{4\left(2-\beta\right)}+\frac{1}{2}\Psi \tag{3.74}$$

3.7.3.2 $i_t \in [\bar{i}_t, 1+\beta]$ for some $\alpha^d_{t+1} \in \left((1-d)\, a^d_t, \min\left\{(1+d)\, a^d_t, m\right\}\right]$

As we can see from the citizens' investment rule, i_t increases as α^d_{t+1} increases. It can be that at some thresold level $\bar{\alpha}^d_t \in \left((1-d)\, a^d_t, \min\left\{(1+d)\, a^d_t, m\right\}\right]$ above which $i_t \geq \bar{i}_t$. In this case, the incumbent will be indifferent in choosing any successor with $\alpha^d_{t+1} \in \left[\bar{\alpha}^d_t, \min\left\{(1+d)\, a^d_t, m\right\}\right]$. According to the incumbents' decision rule about tax rate,

$$\tau^d_{t+1} = 1 + n - a^d_{t+1}$$

and

$$\tau^r_{t+1} = 1$$

In this case, the citizens' investment at period t is

$$i_t = 1 - \tau^r_t \tag{3.75}$$

Plug (3.75) into the indirect utility function of the incumbent, we have

$$V^{od}_{nsw} = \frac{1}{2}\tau^d_t \left(i_{t-1} + Q - \tau^d_t\right) + \frac{1}{2}\Psi \tag{3.76}$$

where

$$Q \equiv 1 - n + a^d_t$$

Taking the first order condition with respect to τ^d_t in (3.76), we have

$$\tau^d_t = \frac{i_{t-1} + Q}{2}$$

and

$$V^{od}_{nsw} = \frac{\left(i_{t-1} + Q\right)^2}{4} + \frac{1}{2}\Psi \tag{3.77}$$

3.7.3.3 The SPNE condition

The condition that ensures the Markov Perfect Equilibrium where all the incumbent dictators choose sufficient weak successors is a Subgame Perfect Equilibrium without retrictions on the successor's strength is the condition that makes the incumbent's indirect utility when choosing an sufficiently weak sussessor, higher than V_{nsw}^{od} for any i_{t-1} and α_t^d in (3.74) and (3.77).

To get the indirect utility of the old incumbent when he chooses a sufficiently weak successor and all the past and future rulers choose sufficiently weak successor, we firstly have

$$V_{sw}^{od} = \tau_t^d \left(i_{t-1} + i_t\right) \tag{3.78}$$

From Proposition 4, we know that $\tau_t^r < 1$ for all $t > 0$. Therefore, if period $t+1$ is not the first period, then $\tau_{t+1}^r < 1$ and

$$i_t = -\frac{(2-\beta)\,\tau_t^r}{2} + \frac{(2-\beta)\,\alpha_{t+1}^d}{2\left(2+\beta\left(1-d\right)\right)} + \frac{2-\beta}{2\beta+4}\left(2\beta - n\beta + 2\right) \tag{3.79}$$

and

$$\alpha_{t+1}^d = \left(1-d\right)\alpha_t^d \tag{3.80}$$

Plug (3.79) and (3.80) in (3.78), and use the fact that $\tau_t^r = \tau_t^d + n - \alpha_t^d$, we get the indirect utility function of the old incumbent if he chooses a sufficiently weak successor:

$$V_{sw}^{od} = \tau_t^d \left(i_{t-1} - \frac{(2-\beta)\,\tau_t^d}{2} + M\right) \tag{3.81}$$

where

$$M \equiv \frac{(2-\beta)}{2}\left(1 + \frac{1-d}{2+\beta\left(1-d\right)}\right) a_t^d - \frac{1}{\beta+2}\left(n-1\right)\left(-\beta^2+\beta+2\right)$$

Taking the first order condition with respect to τ_t^d in (3.81), we have

$$\tau_t^d = \frac{i_{t-1} + M}{2 - \beta}$$

and

$$V_{sw}^{od} = \frac{(i_{t-1} + M)^2}{2(2 - \beta)}$$

If we want to derive the condition to ensure $V_{sw}^{od} > V_{nsw}^{od}$, we must show under what conditions,

$$\frac{(i_{t-1} + M)^2}{2(2 - \beta)} > \frac{(i_{t-1} + N)^2}{4(2 - \beta)} + \frac{1}{2}\Psi \tag{3.82}$$

and

$$\frac{(i_{t-1} + M)^2}{2(2 - \beta)} > \frac{(i_{t-1} + Q)^2}{4} + \frac{1}{2}\Psi \tag{3.83}$$

hold for all $i_{t-1} \in [0, 1 + \beta]$ and $a_t^d \in [0, m]$.

In the following steps, we will derive the conditions that ensure the lower bound of the LHS of (3.82) and (3.83) are larger than the RHS of (3.82) and (3.83) respectively.

Firstly, if we evaluate $\frac{(i_{t-1}+M)^2}{2(2-\beta)}$ at $i_{t-1} = 0$ and $a_t^d = 0$, we get the lower bound of the LHS of (3.82):

$$\frac{(2 - \beta)(1 - n)^2 (1 + \beta)^2}{2(\beta + 2)^2} \tag{3.84}$$

Secondly, if we evaluate $\frac{(i_{t-1}+N)^2}{4(2-\beta)}$ at $i_{t-1} = 1 + \beta$ and $a_t^d = m$, we get the upper bound of the RHS of (3.82):

$$\frac{(2 - \beta)\left(\frac{3+\beta(1-d)}{4+2(1-d)}m + \frac{(1-n)(1+\beta)}{\beta+2}\right)^2}{4} + \frac{1}{2}\Psi \tag{3.85}$$

Thirdly, if we evaluate $\frac{(i_{t-1}+Q)^2}{4} + \frac{1}{2}\Psi$ at $i_{t-1} = 1 + \beta$ and $a_t^d = m$, we get

the upper bound of the RHS of (3.83):

$$\frac{(2+\beta-n+m)^2}{4}+\frac{1}{2}\Psi \tag{3.86}$$

Foruthly, with some simple calsulation, we can see if

$$\Psi<(2-\beta)\left(\frac{2(1-n)^2(1+\beta)^2-(\beta+2)^2\left(\frac{3+\beta(1-d)}{4+2(1-d)}m+\frac{(1-n)(1+\beta)}{\beta+2}\right)^2}{2(\beta+2)^2}\right)$$

holds, then (3.84) must be larger than (3.85) and if

$$\Psi<\frac{2(2-\beta)(1-n)^2(1+\beta)^2-(\beta+2)^2(2+\beta-n+m)^2}{2(\beta+2)^2}$$

holds, then (3.84) must be larger than (3.86).

Now, we can conclude that if

$$\Psi<\min\left\{\begin{array}{c}(2-\beta)\left(\frac{2(1-n)^2(1+\beta)^2-(\beta+2)^2\left(\frac{3+\beta(1-d)}{4+2(1-d)}m+\frac{(1-n)(1+\beta)}{\beta+2}\right)^2}{2(\beta+2)^2}\right),\\ \frac{2(2-\beta)(1-n)^2(1+\beta)^2-(\beta+2)^2(2+\beta-n+m)^2}{2(\beta+2)^2}\end{array}\right\}$$

holds, then it is optimal for the incumbent at period to choose a sufficiently weak successor, giving all the past and future rulers do the same.

Chapter 4

A Politico-Economic Theory of Corruption in Non-Democracy*

4.1 Introduction

Pervasive corruption is a serious problem in non-democratic countries. Figure 4.1 presents the correlation between corruption and democracy across countries[1].

From this figure, we can see that most of the world (82% of the countries or 85.6% of the population) is in non-democracy with a score below 8 in the democracy index, and the corruption index is on average much lower in non-democratic countries. Moreover, in the group of democratic countries, corruption is positively correlated with the degree of democracy while in

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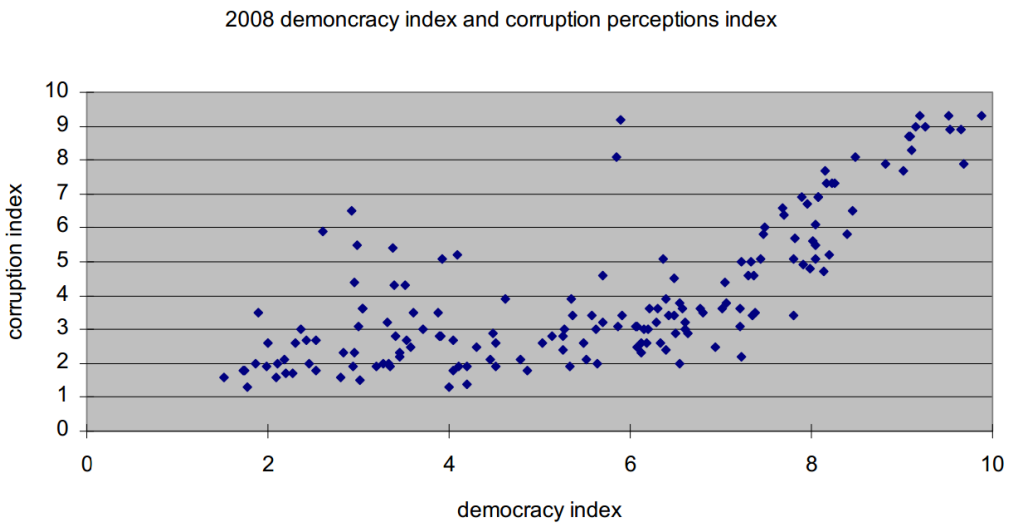
[1]The democracy index on the horizontal axis is the Economist Intelligence Unit's Democracy Index 2008, composed by the Economist. The countries are categorized into "Full Democracies" (scores of 8-10), "Flawed Democracies" (scores of 6 to 7.9), "Hybrid Regimes" (scores of 4 to 5.9), and "Authoritarian Regimes" (scores below 4). The corruption index on the vertical axis is the Corruption Perceptions Index 2008 composed by Transparency International where the higher the score, the lower the degree of corruption.

Figure 4.1: Democracy and Corruption



the group of non-democratic countries, the correlation becomes weak. These findings lead to the following questions. What are the causes of corruption in non-democracy where corruption is pervasive? Are the causes the same in democracy and non-democracy, given the different correlations between corruption and democracies? How to combat corruption in a non-democracy?

To answer these questions, this paper develops a simple dynamic game to analyze the political economy of corruption in non-democratic regimes. The building block is a political agency model with the following assumptions:

1. The change of the ruler is not institutionalized and the major replacement threat to the ruler comes from inside the ruling elite.

2. Different rulers are heterogenous in making policies that affect economic outcomes.

3. The ruler needs to delegate his power to the elite which has the opportunity of being corrupt due to the weakness of the institutions.

Assumption 1 captures a main feature of the non-democratic regime. According to Svolik (2008), an overwhelming majority of authoritarian leaders

lose power as a result of the coup from inside the ruling elite. Assumption 2 captures the fact that the functioning of non-democracy depends on the quality of the leaders. This fact is well documented, for instance, in Jones and Olken (2006) which shows that leaders matter for growth and the effects of individual leaders are strongest in autocratic settings. Assumption 3 is standard in the literature and needs no explanation. Combining the three assumptions leads to a novel and surprising result: a corrupt delegate is politically reliable for the ruler. Specifically, I construct a game with three players: the ruler, the ruler's delegate and citizens. The citizens can support the delegate to replace the ruler, if the delegate can increase the welfare of the citizens by implementing better policies after the replacement. The heterogeneity of the rulers' optimal policies comes from their heterogeneous characteristics, which I model as heterogeneous discount factors. The policy is modeled as the rate at which the ruler taxes the citizens, and the tax rate is determined by trigger strategies between the ruler and the citizens, which means that a lower equilibrium tax rate can be sustained by a ruler with a higher discount factor. The delegate collects the tax for the ruler and due to the weakness of the institutions, the delegate can surcharge the citizens on top of the tax rate set by the ruler. The discount factor of the delegate is private information and can be reflected from this choice of surcharge, which is corruption. If the delegate has a high discount factor, he is patient and tends to choose to be non-corrupt in order to reveal his type to the citizens. This makes the high discount factor delegate have the chance to replace the incumbent in the long run. On the other hand, if the delegate has a low discount factor, he is impatient and prefers to be corrupt in the short run. This makes him lose the chance of getting the support from the citizens and replacing the ruler in the long run. Therefore, an incumbent ruler who is afraid of being replaced may prefer a corrupt delegate who cannot be a political threat. In this sense, being corrupt is one mechanism for the delegate to signal loyalty to the ruler and pervasive corruption is an endogenous outcome

that is optimal for the ruler. There exist multiple equilibria, depending on the strength of the incumbent ruler. If the incumbent is sufficiently strong such that it is too costly for the citizens to replace the ruler, all types of delegates will choose to be corrupt, without revealing their real types. If the incumbent is not sufficiently strong and has a low discount factor, then he prefers a delegate who also has a low discount factor since the delegate will be corrupt and not be a political threat, while a delegate with a high discount factor will be non-corrupt but politically unreliable. If the incumbent is not sufficiently strong but has a high discount factor, all types of delegates will choose to be corrupt, since they have no chance of replacing the incumbent who is "good" enough. Thus, I show that despite the multiplicity of equilibrium, pervasive corruption is likely to exist in non-democracy and in some equilibrium, the ruler has a demand for a corrupt delegate.

The paper contributes to the literature on corruption. To the best of my knowledge, the only strategic interaction between the government and the bureaucrats in all existing models is that since the latter group has some private information, the former should provide the latter with appropriate incentives to induce honesty by paying a high wage, increasing anti-corruption intensity, or increasing the punishment of the corrupt agent, should the price of these incentives not be too high (see, for instance, Acemoglu and Verdier 2000). This implies that corruption is only an *economic* phenomenon that exists in the second best equilibrium for the two following reasons: (i) the asymmetric information and (ii) it is not economically efficient to satisfy the bureaucrat's incentive constraint for not being corrupt. The model adds a political dimension of strategic interaction between the ruler and his delegate. This is non-trivial since it implies that the ruler has a demand for a corrupt delegate. This makes it hard to combat corruption in a non-democracy unless there is a fundamental institutional change. The novelty of my result comes from assumption 1. This is a realistic assumption and has constituted the core of some papers in the recent growing literature on non-democracy.

Egorov and Sonin (2006) and Debs (2007, 2008) explore the incentive for a dictator to keep incompetent agents who are less likely to be a threat of power to the incumbent. Padro-i-Miquel (2007) also shows that due to the uninstitutionalized power transfer, an incumbent dictator can expropriate his supporting group in addition to the ethnic group that is not in power. The reason is that if the dictator is replaced due to the loss of support from his supporting group, there is a chance that the other group can get the power and the supporting group of the current dictator will be expropriated. My paper extends this strand of the literature in the dimension of corruption and shows that the ruler has a demand for corruption due to the possibility of political replacement, which is absent in this strand of literature.

The remainder of the paper is organized as follows. Section 2 provides a case study that motivates the paper. Section 3 presents the model. Section 4 contains a discussion and section 5 concludes the paper. All proofs are in the appendix.

4.2 Case Studies

4.2.1 Case 1[1]

In the autumn of 190 B.C., which is during the Han Dynasty of China, the Emperor, Bang Liu, led the army to suppress a rebellion far away from the capital. Prime Minister, He Xiao, stayed in the capital, in charge of the routine affairs of the government and, more importantly, the logistics for the army. Prime Minister He indeed did a good job. He tried to pacify the people in the capital, encouraged production and, moreover, donated his entire wealth to the army. All these things helped Prime Minister He maintain the good reputation that he already had among the people. However, the absence of the Emperor in the capital gave Premier He the unique chance

[1]This case is from *Records of the Grand Historian: Biography of Prime Minister He Xiao*, by Sima Qian.

of replacing the Emperor, especially with the help of He's good reputation. This made Emperor Bang very upset and he frequently sent emissaries back to the capital, asking around what the Prime Minister was actually doing. Prime Minister He had not realized the danger. But one of the his advisors noticed it and talked to He: "I am afraid that all your family members will be killed soon. You have made significant contributions to the country and your current position is next to that of the Emperor. Furthermore, you have maintained a good reputation among the people for many years and the good job you have done this time when the Emperor has not been in the capital even adds more credit for yourself among the people. The real reason, I think, that Emperor Bang keeps on sending emissaries back is that the Emperor is afraid that if you were to turn against him with the help of your good reputation, then the Emperor would be in a situation where he can neither continue with the war, nor come back to the capital. My advice is that you should defame yourself at this crucial time. This can be achieved, for instance, by borrowing without paying any interest and using the money to buy the land PUBLICLY at very low prices from the farmers, who you can force to sell you the land with your power." Prime Minister He followed this advice, though he was reluctant to do so. However, when the Emperor heard the news from the capital, he became extremely happy and did not punish Prime Minister He at all.

4.2.2 Case 2[1]

In 224 B.C., which is during the Warring State period of China, the State Qin lost an important war against the State Chu. The King of Qin asked an experienced general in the state, Wang Jian, for help.

Wang Jian said, "If Your Majesty is determined to employ me, then I

[1]This case is from *Records of the Grand Historian: Biography of Wang Jian*, by Sima Qian. The English translation is printed on the backcover of *Journal of Political Economy*, Vol. 116, No. 1 (February 2008). The title of in the Journal is "Signaling in the Qin Dynasty".

must have 600,000 men—no less will do!" "Whatever you advise, General," said the emperor. Wang Jian was accordingly put in command of a force of 600,000 men, and the emperor saw him off as far as the Ba River. As they were going on their way, Wang Jian requested the emperor for the gift of a great many fine fields and houses, gardens and ponds. The emperor said, "Just go on your way, General. Why all this worry over poverty?" Wang Jian replied, "Though many of Your Majesty's generals have achieved merit, they have never succeeded in being enfeoffed as marquises. So while I enjoy Your Majesty's favour, I want to use the opportunity to ask for fields and ponds for the sake of my sons and grandsons, that is all." The emperor roared with laughter.

By the time Wang Jian reached the Hangu Pass, he had five times sent messengers back to the capital to repeat his request for suitable farm lands. Someone said to him, "Aren't you being a bit too persistent in the way you beg for rewards, General?" "Not at all," replied Wang Jian. "The king of Qin is suspicious and puts no trust in others. Now he has emptied the state of Qin of all its armed men and turned them over to my sole authority. If I do not ask for a lot of fields and houses for the sake of my sons and grandsons and seem to be thinking only of my own interests, the I will just give him occasion to doubt my motives."

4.2.3 Short Discussions

In both cases, the delegates of the rulers have good chances of replacing the rulers. To send a credible signal of loyalty to the Emperor, the Prime Minister in the first case becomes involved in corruption. In the second case, the General sends a signal of no political ambition to the King by asking for an excessive amount of rewards. This is no difference with corruption in the first case in nature. Through their actions, both delegates defame themselves and lose the support from the people to replace the rulers.

The two case studies clearly show that with the possibility of political

replacement, the ruler needs a delegate without political ambitions or political support to replace the ruler. The delegate, if he wants to be loyal to the ruler, can send the signal of loyalty to the ruler by defaming himself, and this can be achieved at least by being corrupt.

4.3 The Model

4.3.1 The Environment

Consider an infinite horizon economy in discrete time consisting of a group of citizens with mass normalized to 1, a ruler and a delegate who collects tax for the ruler. All agents have a linear preference, maximize the net present discounted value of their utility and discount the future with discount factor β_j, where I use the subscript $j \in \{c, r, d\}$ to denote citizens, ruler, and delegate. While citizens are infinitely lived, an incumbent ruler may be replaced by the delegate should the delegate get the citizens' support and from then onwards, the incumbent receives no utility.

Citizens produce a unique non-strorable final good. There are two types of production technology. The first is home production technology with potential output in each period

$$y_t^H = Z$$

If the citizens use home technology, the final good is not taxable. The second is the market technology with potential output in each period

$$y_t^M = A$$

and $A > Z$. If the citizens use the market technology, the final good will be taxable.

The discount factors of a politician (the ruler and the delegate) can be

high or low. Formally, $\beta_r \in \left\{\beta^h, \beta^l\right\}$ and $\beta_d \in \left\{\beta^h, \beta^l\right\}$, and $0 < \beta^l < \beta^h < 1$. The type of ruler is publicly known and the type of delegate is unknown to all players in the game.

4.3.2 Tax Rate

In every period, the ruler gets the tax revenue T_t and enjoys a non-transferrable ego rent R. The tax rate is determined by trigger strategies between the ruler and the citizens. In general, there can be multiple equilibria, depending on the type of trigger strategies and a higher discount factor of the ruler can usually sustain a lower equilibrium tax rate. To gain analytical tractability, I focus on the simplest case. Assume that the ruler's decision about the tax rate and the citizens' choice of production technology are made simultaneously. If the incumbent ruler deviates from the equilibrium tax rate, the citizens will permanently change to home production in later periods. Given the citizens' strategy, if the ruler wants to deviate, he will set the tax rate to 100%. Therefore, for a given tax base y, unless there is a power struggle between the incumbent and the delegate that I will discuss later, the equilibrium tax rate is determined by the following equation

$$\frac{\tau y + R}{1 - \beta_r} = y + \frac{R}{1 - \beta_r} \tag{4.1}$$

The LHS of (4.1) is the ruler's value if he keeps the promise about the tax rate τ forever. In this case, his has tax revenue τy and ego rent R in every period. The RHS of (4.1) is the ruler's value if he deviates. In this case, he taxes all output in the current period and after that, since the citizens will change to home production, the ruler can only get ego rent R and no tax revenue. The equilibrium tax rate is determined when both sides of (4.1) are equal:

$$\tau = 1 - \beta_r \tag{4.2}$$

From (4.2), we can, other things given, see that the citizen prefers a ruler with a high discount factor, since the tax rate will be low.

4.3.3 Corruption

The delegate collects the tax for the ruler. In a non-democracy, the ruler's power cannot be effectively checked and balanced. Moreover, the power of the delegate comes from the ruler. It cannot be checked and balanced either, since any check and balance means the erosion of the ruler's power. The combination of unbalanced power and the asymmetric information between the ruler and the delegate creates the room for corruption. In the model economy, the delegate can say that a citizen, who has actually paid the tax, has not paid; or the delegate can say that a citizen, who has actually not paid the tax, has paid (Acemoglu and Verdier 2000). Since there is asymmetric information between the delegate and the ruler, and it is costly for the ruler to check, the delegate can always charge on top of the tax rate set by the ruler.

Formally, if the citizens choose market technology and there is a surcharge, the final output is

$$y_t = (1 - s_t) A \tag{4.3}$$

where s_t is the (expected) delegate's surcharge rate in addition to the tax rate set by the incumbent, $s_t A$ is the deadweight loss of output[1] due to corruption, and $s_t (1 - s_t) A$ is the delegate's corrupt income.

However, the surcharge is not unbounded. For a given tax base y_t, it costs γy_t for the ruler to check and retrieve the delegate's corrupt income. The equilibrium surcharge rate s_t^* can be derived by the following equation

$$\tau y_t = \tau y_t + s_t^* y_t - \gamma y_t \Rightarrow \tag{4.4}$$

[1]Mauro (1995) shows that corruption is negatively related to growth and investment, and corruption affects growth through investment. See also Fisman and Svensson (2001) for a study about corruption and growth at the firm level.

$$s_t^* = \gamma \tag{4.5}$$

The LHS of (4.4) is the ruler's tax revenue when he does not check the delegate, for any given tax rate τ. The RHS of (4.4) is the ruler's income when he checks the delegate. The first term τy_t is the tax revenue. The second term $s_t^* y_t$ is the corrupt income he retrieves from the delegate and the third term γy_t is the cost of checking. In equilibrium, if a delegate wants to be corrupt, he will choose $s_t^* = \gamma$ to make the incumbent ruler indifferent between checking or not. For simplicity, let the delegate's choice of surcharge rate be discrete with $s_t \in \{0, \gamma\}$. That is, a delegate either surcharges as much as he can or surcharges nothing. To make the model non-trivial and simple, I make two assumptions on parameter values:

1. $R > \gamma (1 - \gamma) A$
2. $\gamma \geq \frac{\beta_h}{2}$.

Assumption 1 means that the ruler's ego rent per period is higher than the delegate's maximum corrupt income. This gives the delegate the incentive to replace the incumbent ruler when possible. As it turns out later, assumption 2 will ensure that the corrupt income of the delegate is higher than the income of a citizen. This means that the entry condition of the delegate is always satisfied and the ruler does not need to pay the delegate a wage.

4.4 The Political Game

The delegate is the only political threat to the ruler. Citizens replace the ruler with the delegate if the delegate, once he becomes the ruler, provides them with a higher value. The cost of the insurrection is K. Once there is a replacement attempt, it succeeds with certainty and the replaced ruler will receive zero utility. Denote the citizens' insurrection decision as i_t, with $i_t = 1(0)$ corresponding to (not) mounting an insurrection.

Given the setup of the model, a conflict of interest between the incumbent ruler and the delegate arises when the incumbent has discount factor β^l and the delegate has discount factor β^h. Although the delegate's type is his private information, it can be revealed through his surcharge. That is, the delegate has a trade-off when choosing the surcharge. Other things given, if he cares more about current rather than future utility, he will choose a high surcharge. Thus, he will appear less patient to the citizens and lose the chance of being the ruler. While if he is sufficiently patient, the delegate will take less surcharge and reveal his real type to the citizens in order to replace the incumbent ruler in the future. Therefore, the level of surcharge becomes a signal of the delegate's type and a less corrupt delegate will be a potential threat to the incumbent. Although the ruler does not favor any corruption from an economic point of view, he needs it due to the potential political replacement.

4.4.1 The Change of the Delegate

Assume that in the first period and whenever there is a change of delegates with $d_t \neq d_{t-1}$, a new delegate is drawn by the incumbent ruler from the pool of citizens. The distribution of the pool is known. With probability p, a politician has β^h and with probability $1-p$, a politician has β^l. Before choosing the delegate, the incumbent ruler gets a noisy signal θ about the type of delegate

$$\begin{aligned} prob(\theta &= \beta^h|\beta_d = \beta^h) = q \\ prob(\theta &= \beta^l|\beta_d = \beta^h) = 1-q \\ prob(\theta &= \beta^l|\beta_d = \beta^l) = q \\ prob(\theta &= \beta^h|\beta_d = \beta^l) = 1-q \end{aligned}$$

with $q > \frac{1}{2}$. q measures the accuracy of the signal, where the higher the value of q, the more accurate the signal. Based on the signal, the incumbent

chooses the delegate from the pool. Once a given citizen has been chosen, he chooses to be the delegate if his value as a delegate is higher than that of being a citizen.

Finally, assume that in any period, if the delegate does not get the support of the citizens, the incumbent ruler r_t can replace the delegate d_t without any cost. Denote this decision as f_t, with $f_t = 1(0)$ corresponding to (not) replacing d_t

The timing of the game in any period t is as follows.

1. Unless $d_t = d_{t-1}$, the incumbent r_t chooses a delegate after observing the signal θ_t. Denote this decision as ρ, with $\rho(h) = 1(0)$ meaning (not) keeping the delegate when $\theta_t = \beta^h$ and $\rho(l) = 1(0)$ meaning (not) keeping the delegate when $\theta_t = \beta^l$.

2. The incumbent r_t sets the tax rate τ_t and the citizens choose the production technology.

3. The final good y_t is produced and the delegate decides the surcharge rate $s_t \in \{0, \gamma\}$.

4. The citizens decide i_t.

5. The incumbent r_t decides f_t.

4.5 Characterization of Equilibria

The equilibrium strategy profile will be history-dependent. The equilibrium tax rate will depend on the history of the tax rates set by the incumbent ruler. The citizens' insurrection decision and the incumbent ruler's decision about changing the delegate will both depend on the historical performance of the delegate. But if I impose the tax rate determined by the trigger strategy as exogenously given and show that the delegate can be non-corrupt for one period at most, the equilibrium strategies will be Markovian.

Proposition 1. *The maximum number of periods that a delegate remains uncorrupt, defined as T, is one.*

Proof. Suppose that $T > 1$. This means that the citizens will not make the insurrection decision to replace the incumbent ruler in less than T periods. Then, by assumption, the incumbent can always remove the uncorrupt delegate in $T-1$ periods without any cost. This maximizes the ruler's revenue since there is no distortion of the tax base due to corruption and eliminates the risk of being replaced. But knowing this, the delegate will never choose to be uncorrupt for $T-1$ periods and then be removed. The only possibility is $T = 1$ and the citizens immediately make the insurrection decision in one period. ■

4.5.1 Definition of Equilibrium

With the result in Proposition 1 and imposing the tax rate determined by the trigger strategy as exogenously given, the equilibrium strategy profile will be Markovian, which only conditions on payoff-relevant state variables and on the prior actions within the same stage game. In each period, the state of the economy is captured by two variables. The first is the discount factor of the incumbent ruler $\beta_r \in \left\{\beta^h, \beta^l\right\}$. The second is an indicator of whether there is a change of delegates.

$$I_t = \begin{cases} 0, & if \quad d_t = d_{t-1} \\ 1, & if \quad d_t \neq d_{t-1} \end{cases}$$

Formally, let σ be a Markovian strategy mapping, that is,

$$\sigma : \left\{\beta^h, \beta^l\right\} \times \{0,1\} \to [0,1] \times \{0,\gamma\} \times \{0,1\}^4$$

which assigns a value for each of the actions: the tax rate $\tau \in [0,1]$, the delegate's surcharge rate $s_t \in \{0,\gamma\}$, the incumbent ruler's choice of delegate

when there is a change of delegate $\rho(h) \in \{0,1\}$ and $\rho(l) \in \{0,1\}$, the citizens' insurrection decision $i \in \{0,1\}$ and the incumbent ruler's decision about whether to change an existing delegate $f \in \{0,1\}$, for each value of the state variable β_r and I_t. The equilibrium is defined as a set of Markovian strategies that are best responses to each other given the beliefs about the delegate's type which is updated with Bayesian rule and denoted as

$$\mu = prob(\beta_d = \beta^h)$$

In the subsequent analysis, I will characterize the equilibrium in the following three states:

1. State with $\beta_r = \beta^h$ and any I_t defined as the good state G;
2. State with $\beta_r = \beta^l$ and $I_t = 0$ is defined as the bad state B;
3. State with $\beta_r = \beta^l$ and $I_t = 1$ is defined as the transition state TR.

Now I proceed to characterizing the equilibrium by first determining the values of different players under different states.

4.5.2 Values in political state G

In this state, it is straightforward to see that the citizen has no incentive to mount an insurrection because a costly insurrection cannot bring a ruler who is better than the incumbent. Since there is no threat from the delegate, the incumbent ruler is indifferent about the type of delegate. A delegate of any type has no chance of replacing the incumbent ruler and thus surcharges as much as possible. This implies that political state G will be an absorbing state. I summarize the result in the following proposition.

Proposition 2. *For any K, in any subgame with $\beta_r = \beta^h$, the incumbent is indifferent about the type of delegate*

$$V_r\left(G|\rho\left(h\right)=1\right) = V_r\left(G|\rho\left(h\right)=0\right) = V_r\left(G\right)$$

and

$$V_r\left(G|\rho\left(l\right)=1\right)=V_r\left(G|\rho\left(l\right)=0\right)=V_r\left(G\right)$$

delegate's surcharge rate

$$s^*(G)=\gamma.$$

The equilibrium tax rate is

$$\tau^*\left(G\right)=1-\beta^h$$

The incumbent ruler has no political threat from the delegate

$$i^*(G)=0$$

The belief is

$$\mu^*\left(G\right)=p$$

The values of different players are as follows

$$V_r\left(G\right)=\left(1-\gamma\right)A+\frac{R}{1-\beta^h} \tag{4.6}$$

$$V_d\left(G\right)=\frac{\gamma\left(1-\gamma\right)A}{1-\beta_d} \tag{4.7}$$

$$V_c\left(G\right)=\frac{\left(\beta^h-\gamma\right)\left(1-\gamma\right)A}{1-\beta_c} \tag{4.8}$$

Proof. See the Appendix. ■

4.5.3 Values in state B

In this state, the ruler has discount factor $\beta^l$and his ruling is rooted. This state can emerge when (i) the citizens believe that the delegate's type is β^l; or (ii) the insurrection cost K is too high to compensate the gain of

the replacement. Without the possibility of replacing the ruler, the delegate surcharges as much as possible and the citizens never mount an insurrection.

In this subsection, I will only characterize the values of different players, the tax rates and the surcharge rates, leaving the other strategies, the belief and the condition for the existence of this equilibrium to be discussed in the next subsection. I summarize the results in the following proposition.

Proposition 3. *In state B, the tax rate is*

$$\tau^*(B) = 1 - \beta^l$$

and the surcharge rate is

$$s^*(B) = \gamma$$

The values of all players in this state are

$$V_r(B) = (1-\gamma)A + \frac{R}{1-\beta^l} \tag{4.9}$$

$$V_d(B) = \frac{\gamma(1-\gamma)A}{1-\beta_d} \tag{4.10}$$

$$V_c(B) = \frac{\left(\beta^l - \gamma\right)(1-\gamma)A}{1-\beta_c} \tag{4.11}$$

Proof. See the Appendix. ■

4.5.4 Values in political state TR

I now turn to the analysis of the transitional state TR. Recall that this state will emerge when $\beta_{r,t} = \beta^l$ and $d_t \neq d_{t-1}$. Moreover, this state is indeed transient as the model economy will evolve with two possibilities after state TR, depending on the insurrection cost. If the cost is too high, there will be no insurrection and the economy will converge to state B in one period. If the cost is low and $\beta_{d,t} = \beta^h$, there will be an insurrection and the economy

will converge to state G in one period; if the cost is low and $\beta_{d,t} = \beta^l$, the delegate will be corrupt and in one period, the model economy will converge to state B.

4.5.4.1 High Insurrection Cost (K)

In this case, the insurrection cost cannot be compensated by the gain from the replacement of the incumbent ruler. Knowing this, the citizens will not mount the insurrection, although the ruler is the bad type. The delegate, no matter what type he is, has to be corrupt, as there is no chance of replacing the ruler. The ruling of the bad type ruler is therefore rooted and the model economy will converge to political state B in one period. I summarize the equilibrium strategies and the belief about this case in the following proposition.

Proposition 4. *In political state TR, if $K \geq \beta_c [V_c(G) - V_c(B)]$, the incumbent is indifferent about the type of delegate. The delegate's surcharge rate is*

$$s^*(TR, high\ K) = \gamma.$$

The equilibrium tax rate is

$$\tau^*(TR, high\ K) = 1 - \beta^l$$

The incumbent ruler has no political threat from the delegate

$$i^*(TR, high\ K) = 0$$

The belief is

$$\mu^*(TR, high\ K) = p$$

Moreover, the economy converges to state B in one period.

Proof. See the appendix. ■

4.5.4.2 Low Insurrection Cost (K)

In this case, the insurrection cost can be compensated by the gain with the replacement of the incumbent ruler. The citizens will mount an insurrection if they believe that the delegate has β^h. The delegate has different strategies, depending on his type. A delegate with β^l will choose to be corrupt which makes the ruling of the ruler rooted. A delegate with β^h will choose to be non-corrupt and by doing this, he signals his type to the citizens. Since a type β^h delegate is a political threat, the ruler tends to choose a delegate with β^l who will be corrupt. I summarize the result in the following proposition.

Proposition 5. *In political state TR, if $K < \beta_c [V_c(G) - V_c(B)]$, β^l is sufficiently low and β^h is sufficiently high, the incumbent prefers a type β^l delegate and the decision rule of choosing the delegate is*

$$\rho^* (\theta = h | TR, low\ K) = 0$$

and

$$\rho^* (\theta = l | TR, low\ K) = 1$$

The delegate's surcharge rate

$$s^*(\beta_d = \beta^l | TR, low\ K) = \gamma$$

and

$$s^*(\beta_d = \beta^h | TR, low\ K) = 0$$

The equilibrium tax rate is

$$\tau^* (TR | low\ K) = \hat{\tau}$$

where $\hat{\tau}$ is defined in the Appendix. The citizens' decision rule of insurrection is

$$i^* (s = 0 | TR, low\ K) = 1$$

and

$$i^*\left(s=\gamma|TR, low\ K\right)=0$$

The belief is

$$\mu^*\left(s=0|TR, low\ K\right)=1$$

and

$$\mu^*\left(s=\gamma|TR, low\ K\right)=0$$

Moreover, with probability π_2, the model economy converges to state B in one period, where π_2 is defined in the Appendix . With probability $1-\pi_2$, the economy converges to state G in one period.

4.6 Discussion

When the delegate surcharges more than γ, corruption is only an economic phenomenon. In this case, the ruler's economic account is hurt and it is in the ruler's economic interest to combat corruption. How to reduce corruption in this case is the focus of most existing studies. However, if the delegate does not surcharge anything, the ruler's political account is hurt and it is in the ruler's political interest to have a corrupt delegate instead of a non-corrupt but politically ambitious delegate. To the very best of my knowledge, the link between corruption and political replacement is absent in existing studies. When the ruler's political account is open, the analysis on corruption brings new insights.

First, moderate corruption may be a socially efficient mechanism for the delegate to signal his loyalty to the ruler. The effort to reduce corruption can affect the stability of non-democratic regimes and thus reduce welfare, either by impeding the transmission of the signal or by inducing the politicians to use more socially costly ways of signaling.

Second, if we consider a non-democratic regime as a hierarchy composed of rulers at different levels who can be replaced by their delegates, then in

any absorbing state (G or B), corruption is pervasive at all levels. This is an endogenous outcome which is optimal for the rulers rather than bad for the rulers. In other words, the ruler has a demand for surcharge at level γ and has no incentive to fight corruption at this level. This is in sharp contrast to the case in a mature democracy where corruption cannot be favored by a democratically elected leader. Therefore, when analyzing corruption in a non-democracy, it is wrong to assume that the ruler has an incentive to fight corruption and not surprisingly, the policy implication of the analysis based on this assumption might be misleading. On the other hand, as shown by the case studies, once the evidence of being corrupt is publicly known, the delegate cannot be disloyal to the ruler, who can at any time replace the corrupt delegate with the evidence at hand. Corruption makes both the ruler and the delegate politically safer.

Third, the anti-corruption campaign is monopolized by the ruler himself and, obviously, the ruler has no incentive to eliminate the moderate corruption by the politically reliable agents. Therefore, we can expect this kind of campaign to be corruption in nature as it only helps get rid of either an excessively corrupt delegate or, more importantly, the politically non-reliable delegates.

Fourth, the concept of corruption is quite different in a non-democracy to that in a democracy. In the former regime, the government or the ruler is involved in organized crime while in the latter regime, it is purely economic individual crime that the government has an incentive to eradicate. These are fundamentally two different things and not comparable.

4.7 Conclusion

In this paper, I construct a model of corruption in non-democracy. The key assumption is that the delegate can replace the ruler due to the weak institutions. This assumption is non-trivial as it links corruption to the political

account of the ruler. Specifically, the chance for corruption exists due to the lack of a check and balance of power in non-democracy, while corruption itself exists because it is a credible mechanism through which the delegate sends a signal of loyalty to the ruler. On the other hand, the model shows that if there is no corruption, then something goes wrong in the regime. There are two implications of the model. On the policy dimension, it implies that the only way of eradicating corruption in a non-democracy is fundamental institutional change. The empirical implication is that a non-democratic regime with moderate corruption can exist longer. I leave testing of the model to future research.

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4.9 Appendix

4.9.1 Proof of Proposition 2

By (4.2), the tax rate in this state is

$$\tau^{*}(G) = 1 - \beta^{h}$$

As the ruler has a high discount factor, the delegate has no possibility to replace the ruler and will surcharge as much as possible. By (4.5), the equilibrium surcharge rate is

$$s^{*}(G) = \gamma$$

In state G, the delegate's corrupt income in every period is $\gamma(1-\gamma)A$ and the income of a citizen is $\left(\beta^{h}-\gamma\right)(1-\gamma)A$. If the delegate's income is higher than that of the citizen

$$\gamma(1-\gamma)A \geq \left(\beta^{h}-\gamma\right)(1-\gamma)A,$$

then

$$\gamma \geq \frac{\beta^h}{2}$$

This means if Assumption 2 is satisfied, the delegate's entry constraint can be satisfied with zero wage. As the type of the delegate can not be revealed by the surcharge, the citizens's belief is the same as is shown in the prior distribution of the delegate's type.

Knowing the tax rate and income of the delegate and the citizen, it is straightforward to compute the values of the ruler, the delegate and the citizens in state G.

4.9.2 Proof of Proposition 3

By (4.2), the tax rate in this state is

$$\tau^* (B) = 1 - \beta^l$$

As the ruler is rooted, the delegate has no possibility to replace the ruler and will surcharge as much as possible. By (4.5), the equilibrium surcharge rate is

$$s^* (G) = \gamma$$

In state B, the delegate's corrupt income in every period is $\gamma (1 - \gamma) A$ and the income of a citizen is $\left(\beta^l - \gamma\right) (1 - \gamma) A$. If the delegate's income is higher than that of the citizen,

$$\gamma (1 - \gamma) A \geq \left(\beta^l - \gamma\right) (1 - \gamma) A$$

then

$$\gamma \geq \frac{\beta^l}{2}$$

As $\beta^h > \beta^l$, this means if Assumption 2 is satisfied, the delegate's entry constraint can be satisfied with zero wage. As the type of the delegate can

not be revealed by the surcharge, the citizens's belief is the same as is shown in the prior distribution of the delegate's type.

Knowing the tax rate and income of the delegate and the citizen, it is straightforward to compute the values of the ruler, the delegate and the citizens in state B.

4.9.3 Proof of Proposition 4

In this state, the delegate can't replace the incumbent ruler as the insurrection cost is too high. By (4.2), the tax rate in this state is

$$\tau^* (TR, high\ K) = 1 - \beta^l$$

and by (4.5) the equilibrium surcharge rate is

$$s^* (TR, high\ K) = \gamma$$

With the same procedure as in the proof of Proposition 3, the wage of the delegate can be shown to be zero

$$w^* (TR, high\ K) = 0$$

Knowing the tax rate and income of the delegate and the citizen, it is straightforward to compute the values of the three players.

The condition for the existence of this equilibrium is

$$V_c (i = 1 | lTR, high\ K) \leq V_c (i = 0 | TR, high\ K) \tag{4.12}$$

The LHS of (4.12) is the citizens' value if mounting an insurrection and the RHS of (4.17) is the citizens' value without mounting an insurrection. Plug

in the values in the relevant states, (4.12) can be rewritten as

$$(\beta_r - \gamma) A + \beta (c) V_c (G) - K \leq V_c (B) \Rightarrow$$

$$K \geq \beta_c [V_c (G) - V_c (B)] \tag{4.13}$$

As the type of the delegate can not be revealed by the surcharge, the citizens's belief is the same as is shown in the prior distribution of the delegate's type.

4.9.4 Proof of Proposition 5

In this equilibrium, the delegate with β^l will choose to be corrupt while the delegate with β^h will try to reveal the real type to replace the incumbent ruler. The citizens support the delegate with zero surcharge while not support the delegate who surcharges γ. The belief is

$$\mu (s = 0 | TR, low\ K) = 1$$

and

$$\mu (s = \gamma | TR, low\ K) = 0$$

When $d_t \neq d_{t-1}$,the incumbent ruler needs to choose a delegate based on the signal θ_t. If $\theta_t = \beta^h$, the incumbent's value of choosing such a delegate with is

$$\begin{aligned} V_r (\rho (h) = 1 | TR, low\ K) &= T (TR, low\ K) + R - w (TR, low\ K) \\ &\quad + \Pr \left(\beta_d = \beta^l | \theta_t = \beta^h \right) \beta^l V_r (B) \end{aligned} \tag{4.14}$$

where $T (TR, low\ K)$ and $w (TR, low\ K)$ denote the equilibrium tax revenue and wage in political state TR with low K, respectively. Intuitively, if the type β_l incumbent ruler chooses a delegate with $\theta_t = \beta^h$, then he gets the tax revenue and the ego rent in the transitional period. If the delegate turns to have a low discount factor, he will choose to be corrupt and in this case, the

incumbent's power is rooted and the economy will stay in state B forever. The value of $\Pr\left(\beta_d = \beta_l | \theta_t = \beta^h\right)$ can be obtained by Bayesian rule

$$prob\left(\beta_d = \beta^l | \theta_t = \beta^h\right) = \frac{(1-p)(1-q)}{pq + (1-p)(1-q)} \equiv \pi_1$$

The incumbent's value of choosing a delegate with $\theta_t = \beta^l$ is

$$\begin{aligned} V^r\left(\rho\left(l\right) = 1 | TR, low\ K\right) &= T\left(TR, low\ K\right) + R - w\left(TR | low\ K\right) \\ &\quad + \Pr\left(\beta_d = \beta^l | \theta_t = \beta^h\right) \beta^l V^r\left(B\right) \end{aligned} \tag{4.15}$$

The value of $\Pr\left(\beta_d = \beta^l | \theta_t = \beta^l\right)$ can be obtained by Bayesian rule

$$\Pr\left(\beta_d = \beta^l | \theta_t = \beta^l\right) = \frac{(1-p)\,q}{p\,(1-q) + (1-p)\,q} \equiv \pi_2$$

Comparing (4.14) and (4.15), it is easy to see if $q > \frac{1}{2}$, then

$$\pi_1 < \pi_2,$$

$$\rho^*\left(\theta_t = \beta^h | TR, low\ K\right) = 0$$

and

$$\rho^*\left(\theta_t = \beta^l | TR, low\ K\right) = 1.$$

The intuition is that, as the type β^l incumbent ruler wants to keep power and a type β^h delegate will be a threat of power, the incumbent prefer a type β^l delegate. If the quality of the signal is better than that from throwing a coin, the incumbent trusts the signal and always chooses a delegate with $\theta_t = \beta^l$.

Given π_2, the output in this state is

$$y\left(TR, low\ K\right) = \left(1 - \pi_2 \gamma\right) A$$

where $\pi_2 \gamma$ is the expected surcharge rate.

The tax rate at this state is determined again by trigger strategy from the following equation

$$\begin{aligned} & \tau\left(TR, low\ K\right) y\left(TR, low\ K\right) + R + \beta^{l}\pi_{2}V_{r}\left(B\right) \\ = \ & y\left(TR, low\ K\right) + R + \beta^{l}\pi_{2}\frac{R}{1-\beta^{l}} \Rightarrow \end{aligned} \tag{4.16}$$

$$\tau\left(TR, low\ K\right) = \frac{1-\pi_{2}\gamma-\beta^{l}\pi_{2}\left(1-\gamma\right)}{\left(1-\pi_{2}\gamma\right)} \equiv \hat{\tau}$$

The LHS of (4.16) has two parts. The first and the second term are incumbent ruler's tax revenue and the ego rent in this state. The last term is the expected value of keeping power after the current period. The sum of the two parts is the incumbent's expected value of keeping promise about tax rate $\tau\left(TR, low\ K\right)$ at this state. The RHS of (4.16) is the incumbent's value if he deviates from the tax rate $\tau\left(TR, lowK\right)$and sets the tax rate to 100% ex post. In this case, the ruler gets all the output and after that, the incumbent only get the ego rent, if he can keep the power.

With the tax rate and output at this state, the value of the incumbent at this period is

$$V_{r}\left(TR, low\ K\right) = T\left(TR, low\ K\right) + R - w\left(TR, low\ K\right) + \beta^{l}\pi_{2}V_{r}\left(B\right)$$

Now we consider the decision of the delegate with β^{l}. In this equilibrium, such delegate chooses to be corrupt in every period rather than surcharging nothing and trying to replace the incumbent.

The type β^{l} delegate's value of surcharging γ is

$$\begin{aligned} V_{d}\left(s=\gamma|low\ K, TR, \beta_{d}=\beta^{l}\right) \ = \ & \gamma y\left(TR, low\ K\right) + w\left(TR, low\ K\right) \\ & +\beta^{l}V_{d}\left(B, \beta_{d}=\beta^{l}\right) \end{aligned} \tag{4.17}$$

The intuition of (4.17) is that if the type β^{l} delegate chooses to be corrupt at state TR, he can get the surcharge $\gamma y\left(TR, low\ K\right)$ and wage $w\left(TR, low\ K\right)$

in the current period. Moreover, the delegate can remain his position and be corrupt in the future as in this case, the economy will converge to state B in one period. The type β_l delegate's value of being non-corrupt is

$$V_d\left(s=0|low\ K,TR,\beta_d=\beta^l\right)=w\left(TR|low\ K\right)+\beta^l V_r\left(TR,low\ K\right) \quad (4.18)$$

The intuition of (4.18) is that if the type β^l delegate chooses to be non-corrupt in this state, then he will gets the support form the citizens and become the ruler in the next period. But as his type will be revealed then and he needs to choose a delegate, the next period will again be state TR. Comparing (4.17) with (4.18), the type β^l delegate will choose to be corrupt if

$$V_d\left(s=\gamma|low\ K,TR,\beta_d=\beta^l\right)>V_d\left(s=0|low\ K,TR,\beta_d=\beta^l\right)\Leftrightarrow$$

$$\left(1-\beta^l\right)\left(\gamma-\beta^l\right)\left(1-\pi_2\gamma\right)A>\beta^l\left[R-\gamma\left(1-\gamma\right)A-\beta^l\left(1-\pi_2\right)R\right] \quad (4.19)$$

The smaller the value of β^l, the more likely that (4.19) holds.

Now consider the decision of the delegate with β^h. The type β^h delegate's value of surcharging γ is

$$\begin{aligned} V_d\left(s=\gamma|low\ K,TR,\beta_d=\beta^h\right) &= \gamma y\left(TR,low\ K\right)+w\left(TR,low\ K\right) \\ &\quad +\beta^h V_d\left(B,\beta_d=\beta^h\right) \end{aligned} \quad (4.20)$$

The intuition of (4.20) is that if the type β^h choose chooses to be corrupt, then he can not get to support from the citizens to replace the incumbent ruler. After the current period, the delegate can continue to be corrupt in the following periods.

The type β^h delegate's value of being non-corrupt is

$$V_d\left(s=0|low\ K,TR,\beta_d=\beta^h\right)=w\left(TR|low\ K\right)+\beta^h V_r\left(G\right) \quad (4.21)$$

The intuition of (4.21) is if the type β^h delegate chooses to be non-corrupt, then he will gets the support form the citizens and become the ruler in the next period.

The condition that the type β^h delegate chooses to be non-corrupt is

$$V_d\left(s=\gamma|low\ K,TR,\beta_d=\beta^h\right)<V_d\left(s=0|low\ K,TR,\beta_d=\beta^h\right)\Rightarrow$$

$$\gamma\left(1-\pi_2\gamma\right)A<\beta^h\left[\left(1-\gamma\right)A+\frac{R-\gamma\left(1-\gamma\right)A}{1-\beta^h}\right] \tag{4.22}$$

Clearly, given the assumption that

$$R-\gamma\left(1-\gamma\right)A>0,$$

(4.22) is more likely to be satisfied with higher β_h and higher R.

Now we consider the entry condition of the types of delegate. For the type β^l delegate, with the same procedure as the proof of Propositions 2 and 3, it is straightforward to show that if $\gamma\geq\frac{\beta^h}{2}$, the wage for the type β^l delegate is zero in this state. For the type β^h delegate, if (4.22) holds, the delegate will always choose to replace to incumbent. Any positive wage only makes the entry condition of this type delegate more likely to hold. Thus, the ruler has no incentive to pay any positive wage to the type β^h delegate in this state.

The insurrection decision by the citizens is the determined by the citizens' values when making choices of insurrection upon observing the delegate's surcharge. In this state, the citizens will only support the delegate when observing $s_t=0$.

When $s_t=0$, if $i_t=0$, the economy will be ruled by the type β^l ruler forever, and the delegate will surcharge γ in every period. The citizen's value is

$$V_c\left(i=0|TR,low\ K,s=0\right)=\left(1-\hat{\tau}\right)y\left(TR,low\ K\right)+\beta_cV_c\left(B\right) \tag{4.23}$$

When $s_t = 0$, if $i_t = 1$, the citizen's value is

$$V_c\left(i = 1|TR, low\ K, s = 0\right) = \left(1 - \hat{\tau}\right) y\left(TR, low\ K\right) - K + \beta_c V_c\left(G\right) \quad (4.24)$$

Comparing (4.23) and (4.24), the condition for the existence of insurrection is

$$V_c\left(i = 1|TR, low\ K, s = 0\right) > V_c\left(i = 0|TR, low\ K, s = 0\right) \Rightarrow$$

$$K < \beta_c\left[V_c\left(G\right) - V_c\left(B\right)\right] \quad (4.25)$$

Summing up, Proposition 5 holds if (4.20), (4.22) and (4.25) hold.

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