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Author

WANg, GANG

Publication Date

2013

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By

Gang Wang

A dissertation submitted in partial satisfaction of the

Requirement for the degree of

Doctor of Philosophy

in

Political Science

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Gérard Roland, Chair
Professor Lowell Dittmer
Professor Wen-hsin Yeh
Professor Peter Lorentzen

Fall 2013

Abstract

The Power Structure and Its Political Consequences

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Gang Wang

Doctor of Philosophy in Political Science

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Professor Gérard Roland, Chair

Chapter one develops a dynamic model to investigate the paradox of the Chinese state-society relations before and after the reform. By assuming that citizens and the government are both forward looking and protestors in the CCP regime have to pay the durable cost, the model generates several findings. First, the model identifies an increasing number of protests in a transition economy because the decentralized reform has induced such significant changes as the weakened central authority, released social control and increased distributable income. Second, a low level of social unrests is found in both stationary and non-stationary equilibrium in a central planning economy. Third, the model demonstrates the strong capability of a command economy in administrating economic crisis. Finally, the future tendency of the Chinese state-society relations depends on the re-strengthening of central authority and the techniques that the center will apply to respond the mass incidents.

Chapter two develops the Crowford and Sobel's cheap talk model (1982) and Hoff and Stiglitz's model of anarchy of demand for the rule of law (2004), and investigates the significance of peasants' rebellions on Chinese dynastic stability and the large variance in the duration of reign within the dynastic cycle. I contend that dynastic stability is determined by the initial land distribution and the center-local relationship in the Central Autocratic System. As the center cannot constrain the local corruption, the portion of peasant proprietors and thus dynastic stability has a tendency of decreasing over time. In addition, the patterns of dynastic longevity are shaped by the type of preceding wars before the dynasty was built.

Very few researches focus on the role of judicial system in determining the level of corruption. Employing a formal model with empirical analyses, Chapter three incorporate economic factors with political constraints to investigate the different roles of democracy and judicial independence in determining the level of bureaucrats' corruption across countries. Empirically, the instrumental variable (IV) approach is applied to resolve the endogeneity problems. The evidence indicates that different levels of corruption across countries are significantly influenced by the degrees of judicial independence. To fight corruption successfully, I contend that the judiciary, as a hard institutional constraint to resist bureaucratic corruption, has to be independent from the government.

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Chapter 1

Stable in Economic Hardship, Unrest in Economic Prosperity
—The Paradox of Social Stability in the CCP Regime

1. Introduction

After the establishment of the People's Republic of China in 1949, China has experienced two different development stages. From the early 1950s to the late of 1970s, the Chinese Communist Party (CCP) pursued a "Big Push industrialization" strategy and a central planning economy was adopted in China's authoritarian regime. During this period, the Chinese people were only provided with basic material needs and it is estimated about 25-30 million people died due to the terrible famine of 1959-1961 (Naughton, 2007). The state-society relationship in the Mao era was characterized by politically vulnerable citizens and a strong central authority (Lieberthal, 2004). Since the end of 1970s, the China's reform accompanied by a relaxation of controls over economy and society (Perry and Selden, 2003) has made profound changes in the state-society relationship. Despite rapid economic growth and untouched political system, the number of protests or collective incidents increased from 8,709 in 1993 to 87,000 in 2005 (Yu, 2007) and an estimated 180,000 in 2010 (Demick, 2012).

For good reasons, protests reflect instability in authoritarian regimes (Chen, 2000; Lorentzen, 2013). And Chinese history has a record of resistance and revolt second to none (Perry and Selden, 2003). A growing literature has investigated the many aspects of the Chinese collective incidents occurred in the past 20 years and Mao's regime has been criticized almost from the every possible point. But one thing slips our mind: why was the CCP regime so stable in the Mao era when people were experiencing economic hardship even in mass starvation whereas an increasing number of protests have been seen during the economic reform?

This paper develops a dynamic model (Bond and Samuelson, 1984, 1987) and applies Markov perfect equilibrium (MPE) to investigate the paradox of the Chinese state-society relationship before and after the reform. By assuming that citizens and the central government are both forward looking and protestors in the CCP regime have to pay a durable cost, the model generates several important implications. First, a central planning economy can usually maintain its social stability in that the government is the sole employer and people's consumption is sustained at the basic level for a long time. This implies the durable cost associated with the protest activities is extremely high but the potential benefit of the protests is low before the economic transition. Accordingly in both stationary and non-stationary MPEs, the citizens would prefer to shrink the level of collective incidents. From the government's perspective, as long as the state is able to control the whole economy efficiently through a command system, a MPE can be reached in which the citizens will only show their loyalty to the center. This is "*the Road to Serfdom*" (Hayek, 1944), rather than the path to rebellion.

Furthermore, the model demonstrates the strong capability of a command economy in administrating economic crisis. Specifically, since the central government is

able to change its policy quickly through a centralized bureaucratic and economic system, the citizens' expectation on the continuation of crisis is disrupted. In addition, the "rent" for escalating the level of protests does not exist as the central planning government is never willing to release the centralized power and the durable punishment. By contrast, the Chinese government in the imperial age certainly had no such capabilities in handling economic crisis—it did have a bureaucratic system but the country's economy was decentralized and controlled by the local landlords (Hucker, 1973; Liu et al, 2005). That's why hundreds of thousands of peasants' revolts had been observed in the Chinese history but nothing happened in the Chinese Great Famine of 1959-1961.

Third, the model investigates the complicated theoretical relationship between economic growth and social stability in a transition economy. Although the Deng reforms tried to decentralize the state economy by replacing central planning with market forces, the social stability was maintained in the 1980s as China's economy was still state-dominated at that stage. However, an increasing number of protests are identified thereafter in both stationary and non-stationary MPEs because the decentralized reform has induced three significant changes in the dynamic process of transition since the early 1990s. One, the durable punishment the government can enforce to the protestors has been greatly decreased because fewer and fewer people adhere to the state-owned economy and various social controls such as the household registration system have been partially released. Two, though the centralized bureaucratic system remains frozen, the economic development and liberalization delimit the central government's role[1] and encourage local corruption (Yang, 2004; Sun, 2004). Consequently, the center's policy cannot be delivered as efficiently as it was in the Mao era no matter whether the policy itself is good or bad. This implies the rent for protesting has been released during the economic transition. Last, the rapid economic growth, especially the growth of distributable income, increases the rental price of collective incidents.

Certainly, the uprising protests in the past 20 years do not necessary mean it will continue getting along with the future economic growth. As the protest punishment keeps going down and political structure leaves untouched, the model predicts that the future tendency of the Chinese state-society relationship depends on two conditions: (1) whether the center will be able to constrain its local agents' behavior and strengthen the central authority; (2) whether the center will respond the mass incidents quickly and resolve the social problems efficiently. With these two conditions, the level of instability is expected to decrease accompanied by the continued economic growth.

This paper contributes to contradictory theories of the effects of economic performance on regime stability in comparative studies. The more widely recognized "good growth hypothesis" insists that people be inclined to support the government as higher incomes are induced by economic growth (Paldam, 1998). With different empirical techniques, the positive correlation between economic performance and stability has been identified in many cross national studies (Barro, 1991; Hibbs, 1973;

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[1] Some scholars argue that it is the center who decentralized power for the purpose of increasing incentives and productivity (see Liou, 2000). Since the model focuses on the outcomes of social stability, the endogeneity on this issue is not concerned.

Londregan and Poole, 1990). Correspondingly, the "destabilizing growth hypothesis" contends a more complicated society generated by economic growth inspires unrest social movements. In a well-written paper, Olson (1963) discussed the destabilizing forces accompanied by the rapid growth in great detail. In Chinese studies, a large volume of literature has analyzed how the profound changes in the Chinese society since reform promote the collective incidents (Cai, 2002; Lorentzen, 2013; O'brien and Li, 2006; Perry, 2001; Wright, 2010). More valid observations as well as the more careful measure and endogenous treatment will certainly improve the empirical wisdom on this debate (Paldam, 1998; Lorentzen, 2013). However, my model and China's experience in the past 60 years suggest that the social stability in a changing society should be more complicated than what economic performance can predict: (1) the level of social unrests is more likely promoted by the growth of distributable income rather than the growth of GDP. (2) Though in most cases these two variables are correlated, the model and China's experience demonstrate that the type of the growth played a more important role than the speed of the growth in determining the output of social unrests level. China's economic growth throughout the 1980s, for instance, was categorized as a Pareto-improving reform or "reform without losers" (Lau, Qian and Roland, 2000). Since the 1990s, the large scale privatization reform has produced losers (Qian, 2003) and was associated with the uprising protests. (3) One thing is identified in the model but seldom discussed in the literature is that the government's techniques in handling collective incidents matter. Specifically, if the local officials are willing to make a quick response to the mass incidents, then the period length of every stage game is decreased and the citizens would prefer to shrink rather than expand the level of collective incidents. According to Yu (2007), many large scale protests happened because the local governments failed to react to citizens' complaints initially.

Another contribution is that this paper develops a dynamic model which provides a framework for the future research on the Chinese state-society relations. While this paper sketches an explanation of the styles of the development of social protests, it emphasizes on why the level of protests is escalated and on the conditions that affect whether citizens decide to escalate or not. The explanation is not completely novel, as it corresponds to many versions of the Chinese unrest story. Nor is it an attempt against alternatives. Rather, the purpose of this paper is to develop a formal model in which state-society relations are the joint outcome of the interaction of economic transition and political power distribution. In the end, the model predicts the state-led development may not move China into a democratization process (Bellin, 2000; Wright, 2010). Rather, re-strengthening central authority to constrain local governments' scope of power is expected and a stable authoritarian market regime is sustained.

2. State-Society Relations Before and After Reform

The Chinese state-society relations in the Mao era is unstable and violent (Lieberthal, 2004) and the period of the Culture Revolution is supposed to own the largest number of mass movements in the Chinese history—though the statistical data is absent. A distinct difference of the state-society relations of the model interest before and

after reform,[2] however, is not the scale of the various movements, but the role of citizens in the movements. Except for the early 1950s,[3] Chinese state-society relations were categorized as a state-dominated one (Liou, 2000; Lieberthal, 2004) in which most mass movements were top-down affairs and citizens were mobilized by political leaders for political combat (Walder and Gong, 1993; Perry, 1994). Not until the late 1980s did the Chinese citizens become an independent player and the uprising social unrests were labeled as the bottom-up activities. The changing relations between the society and the state associated with economic growth since 1978 may undermine the legitimacy of the CCP regime and threaten its political stability (White, 1993). Three aspects discussed below may have significant effects in shaping the different patterns of the bottom-up collective incidents in China's two development stages.

2.1 Released Social Control

In the Mao era, the strong state controlled almost every aspect of the peoples' social life through a huge and complex administrative structure and other institutions (Liou, 2000; Lieberthal, 2004). The CCP controlled the country through working units as well as residents' committee in urban areas, and the production brigade (*sheng chan da dui*) in rural areas. In terms of institutions, the party-controlled system implemented Household Registration System (*hukou*), profile management (*dangan*), food ration policy, and the work-point system. Although these institutions aimed at promoting heavy industrialization rather than punishing protestors, they restrained people's mobility and political participation, just as Hayek (1944) cited what Trotsky (1937) said:

"*In a country where the sole employer is the State, opposition means death by slow starvation. The old principle: who does not work shall not eat, has been replaced by a new one: who does not obey shall not eat.*"

The post-Mao reforms dramatically reduced the party's social control since many old control policies had been relaxed for the purpose of promoting productivity. For example, the Household Responsibility System (*bao chan dao hu*) was in place to allow farmers to make own decision on agricultural production; the *hukou* system was relaxed to tolerate rural urban migration for economic growth; the burgeoning private sectors created new employment opportunities, absorbed surplus labor and boosted economic growth; the number of state-owned enterprises had been significantly reduced, and the working units reduced their traditional administrative control of social and economic changes. In sum, the economic success of market reform has significantly reduced the potential durable cost for the protestors (Chen, 2000; Liou, 2000).

2.2 Increased Distributable Income

In Chinese studies, the rapid growth of GDP since reform is often praised. As a matter of fact, the average annual growth rate of GDP from 1952 to 1978 is around 6.0%.

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[2] More precisely, the 1989 Tiananmen movement should be viewed as the dividing crest of Chinese state-society relations in the sense of people mobilization in the social movements (see Walder and Gong, 1993; Perry, 1994).

[3] Before the Anti-Rightist Campaign, bottom-up social movements still existed in the Chinese society (see Perry, 1994; *Prevention and Disposal of Mass Disturbances*, 2009).

Considering the impacts of the three year natural disaster and the Culture Revolution, the number is not significantly low compared to the annual growth rate of 9.7% from 1978 to 1998 (Chow and Li, 2002). Therefore, it is inappropriate to compare the state-society relations in the CCP regime before and after reform according to the GDP growth rates.

However, the existence of uprising bottom-up protests since reform implies there must be some economic benefits to the protestors. In the Mao era, the gross capital formation grew around 10.4% annually but the per capita household consumption grew at an annual rate of 2.3% on average (Naughton, 2007). As the citizens were not willing to challenge the heavy industry Big Push strategy, the space of bargaining with the government on the distributable income before the economic reform is very limited. In contrast, the annual household consumption rate was around 8% in the past two decades and 10% in the past few years (Baker and Orsmond, 2010). In a protesting game (not a revolt game) with the government, the citizens expect to change the government policies rather than challenge the government priority strategies such as the heavy industry or the economic growth priorities. In handling collective incidents, the center usually offers some compensation to the unrest citizens and punishes its local agents (Cai, 2010) and this has been a typical norm of the Chinese central government since its imperial times (Perry, 2001). Therefore, the distributable income in China's two development stages plays a key role in shaping the different patterns of social stability. [4]

2.3 Weakened Center Authority

While it is commonly asserted that China's political system still remains frozen (Perry and Selden, 2003), more and more evidence shows the central government's authority has been greatly challenged since the 1980s in many aspects. The first issue is the rampant official corruption since reform (Liou, 2000; Lorentzen, 2013; Root, 1996; Sands, 1990; Wedeman, 2004). Though the political campaigns were organized for fighting corruption in the past two decades, the prevailing corruption has not decreased as a result (Rooij, 2005). According to Transparency International, China has been among the "highly corrupt" countries. The second issue is the central government's capability of controlling over economy, social affairs and local officials as the social changes has caused a redistribution of social power from the state to others (White, 1991). According to the 2002 Rural Land Contracting Law, for example, the rural households were supposed to receive their usage rights from the local governments, but less than half of households had received the official documents by 2005 (Dean, 2006). The official press, People's Daily (2005) acknowledged that over one million cases of illegal seizure of land were reportedly uncovered between 1998 and 2005 (Lorentzen, 2013). Cody (2008) argues that it is the local governments' incentive for substantial revenues caused the prevailing illegal land seizures. The third issue relates to changes in individual and social ideology. The ideological and attitudinal changes since the reform have been well discussed by some researchers (Shih, 1995; Ferdinand, 1996; Lieberthal, 2004), including

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[4] In a market economy, the GDP growth rate and the growth of distributable income are usually highly correlated. But in a central planning economy, if the central government prefers to keeps the peoples' income at a low level over a long run to push the industrialization, then the two variables are highly likely independent from each other.

the diminishing role of the state in directing people's daily life, the rising social inequality, and lack of social trust.

3. The Dynamic Model

The following model is based on Bond's and Samuelson's durable goods model. Bond and Samuelson (1984, 1987)[5] build a dynamic model to study the behavior of durable goods monopolies and how rational expectations as well as period length influence the durable goods stock compared to the competitive market. In the dynamic process of the state-society relations in China, the citizens usually have to pay a durable cost once they participate in a collective incident. Thus when the citizens make a protest decision, not only should they analyze the cost-benefit in the current stage, but take into account the influence of the protest participation on their future payoff.

3.1 Setup

There are two players in the game: a central government, the player i, and the identical citizens, the player j. The dynamic game goes to infinite and each stage is indicated by $t = 0, 1, 2,... + \infty$. Suppose the period length of each stage game is denoted as Δ and the discount factor for Δ is $e^{-\lambda\Delta}$ where $\lambda \in (0, +\infty)$. The citizens' strategy is to choose a level of protesting at the beginning of each stage game. The citizens' protest decision is certainly based on their cost-benefit analysis and the existence of the collective incidents implies there must be some benefits associated with protesting activities.

Assumption 1: A Durable Cost for Protestors

A durable cost refers to the total cost the citizens have to pay in each stage game after a protest happens. In the CCP regime, many institutions such as the household registration system, work unit, profile management system, etc., enforce a long-term punishment and thus a durable cost for protestors. These institutions, however, were not designed to prevent the Chinese people from protesting. The state-owned enterprises and the household registration system, for examples, were designed for the construction of socialism and heavy industry priority strategy rather than punishing people who involved in anti-government activities. But in practice, these institutions do have a function of enforcing a durable cost on the protestors. Similarly, the released social control during the reform aimed to promote economic growth instead of encouraging mass incidents. Therefore, in this paper the cost associated with protest activities is initially institutionalized as a durable cost by the authoritarian regime and is taken as an exogenous variable.

The Citizens

At the beginning of each period, the player j picks up a level of collective incidents $R(t) \in [0, 1]$ where a larger $R(t)$ implies a higher level of protests and the

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[5] The model can be seen in Mailath and Samuelson (2006) as well.

central government, player i, will be facing a consistent $R(t)$ level of mass incidents throughout the stage. For any $R(t)$ the citizens select, there is a durable punishment positively associated with $R(t)$ at a depreciation rate $e^{-\eta t}$ over the whole game. Although the citizens' period t strategy is to pick up the level of $R(t)$, it is more convenient in the model setup to treat the citizens as selecting the stock of the punishment, $X(t)$, enforced by the exogenous institutions subject to $X(t) \geq X(t-1) \times e^{-\eta \Delta}$.[6] The citizens' strategy is thus to choose a sequence of stocks $\{X(0), X(1), X(2), \dots\}$. Since a high flow of the punishment usually indicates a high level of collective incidents, let $R(t) = \dfrac{X(t) - X(t-1) \times e^{-\eta \Delta}}{K}$ indicates the protesting level in period t, where exogenously determined K is the capacity level of punishment the citizens can afford in each stage.[7] I assume K is large enough so it does not bind in the equilibrium but $K < +\infty$ and $K \geq X(t) - X(t-1) \times e^{-\eta \Delta}$ for any t. Obviously, by fixing $X(t-1)$, $\dfrac{dR(t)}{dX(t)} = \dfrac{1}{K} > 0$.

For any $X(t)$, the citizens are supposed to pay a durable cost with the depreciation rate at $e^{-\lambda t}$ over the whole game. Assume $c^j(X(t)) = \beta \times X(t)$ is the instantaneous valuation (or the inverse demand curve) attached to $X(t)$ in the stage game where β is explained as the cost coefficient enforced by exogenous institutions. Thus the cost associated with per unit of $X(t)$ in the stage game is

$$
\begin{aligned}
C^j(X(t)) &= \int_0^\Delta [c^j(X(t)) \times e^{-\eta s}] \times e^{-(\lambda+\eta)s} ds \\
&= \frac{1 - e^{-(\lambda+2\eta)\Delta}}{\lambda + 2\eta} \times c^j(X(t)) \\
&= \beta(\lambda, \eta, \Delta) X(t)
\end{aligned}
$$

Because the durable punishment lasts to infinite, given the sequence $SC^j(X(t)) = \{C^j(X(t)), C^j(X(t+1)), C^j(X(t+2)), \dots\}$, the marginal cost of the punishment is defined as: $MC^j(X(t), t) = \sum_{s=0}^{+\infty} [e^{-(\lambda+\eta)\Delta s} \times C^j(X(t+s))]$. The citizens'

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[6] This constraint does not bind in the equilibrium I construct, so it can be ignored.

[7] Another potential measure could be $R(t) = \dfrac{X(t) - X(t-1) \times e^{-\eta \Delta}}{K - X(t-1) \times e^{-\eta \Delta}}$. However, a concern with this measure is that it cannot demonstrate the tendency of the state-society relationship very well. For example, if $X(t-1) \times e^{-\eta \Delta}$ is very large and close to K, then even a large $\dfrac{X(t) - X(t-1) \times e^{-\eta \Delta}}{K - X(t-1) \times e^{-\eta \Delta}}$ doesn't make too much sense for both sides.

strategy is thus to choose a sequence of stocks $\{X(0), X(1), X(2), ...\}$ to maximize their benefits.

The Central Government

Generally speaking, the collective incidents are not preferred by the central government. However, just as Cai (2010) and Perry (2001) contend, when handling collective incidents, the center usually offers some compensation to the unrest citizens and this has been a typical norm of the Chinese central government.[8] In this paper, the compensation strategy is explained by a derived demand on the grassroots' protests. There are at least two types of the derived demand existing in the CCP regime. The first one is the derived demand of economic interest. A typical case in this point is pollution. In order to promote economic growth, the government has to tolerate some level of pollution produced by the local factories. In this situation, a certain level of pollution can be seen as the government's derived demand of economic interests.[9]

The second one is the derived demand of institutional interest. There are many concerns with the central authoritarian regime in China, but the political system has remained untouched thus far. To maintain the current political system, some types of social unrests are within the top leaders' expectation. These protests can be seen as the outcome of the government's derived demand of institutional interest. In "Rightful Resistance in Rural China," for example, O'Brien and Li (2006) investigate the emergence of some types of protests derived from the gap between the promised policies (by the central government) and the delivered policies (by the local). Lorentzen (2013) contends that some collective incidents have a function of helping the central government gather information about its local agents. Thus these protests are even encouraged by the top leaders. As the political reform keeps frozen, the existence of some protests can be viewed as the institutional demand of the central government.

In sum, the government's strategy is then simplified as to pick up a "price" for a certain level of protests given that the derived demand on the level of protests. Assume the government's inverse demand function of the collective incidents is

$$f^i(R(t)) = z(1-\alpha)(1-R(t)))$$

where $z > 0$ is the index of distributable income so generally the citizens' expectation on the benefits of the protests increase as the country grows rich. $\alpha \in [0, 1]$ indicates the central government's authority, or the efficiency of policy delivery. $\alpha = 1$ is the case of complete efficiency; and $\alpha = 0$ means the complete inefficiency. Obviously,

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[8] The center certainly has ability to repress the protests just like what the government did in Tiananmen Movement and Falungong Movement. However, "compensation" is a much more often used strategy than "repress." This paper only focuses on "compensation" strategy.

[9] The recent protests happened in Qidong, Jiangsu Province and Ningbo, Zhejiang Province are typical examples of this point. The details can be seen in:
http://online.wsj.com/news/articles/SB10000872396390044393140457755430214156 5274
and
http://online.wsj.com/news/articles/SB10001424052970204840504578084620690324436

if the central policy can be delivered efficiently, the citizens' expectation on the benefits of the mass incidents decreases.

Since $R(t) = \dfrac{X(t) - X(t-1) \times e^{-\eta\Delta}}{K}$ is defined earlier, $f^i(R(t))$ can be transferred into the following one:

$$f^i(R(t)) = z(1-\alpha)(1-R(t))) = z(1-\alpha)(1 - \frac{X(t) - e^{-\eta\Delta}X(t-1)}{K}) = f^i(X(t)|X(t-1))$$

So the government's derived demand on $R(t)$, the level of protests, is expressed as the derived demand on $X(t)$, the stock of the punishment.

Similar to $c^j(X(t))$, here $f^i(X(t)|X(t-1))$ is the instantaneous valuation the government attaches to per unit of $X(t)$ in the stage game as well. Thus the value per unit the government assigns to $X(t)$ throughout the stage game at the beginning of a period is

$$
\begin{aligned}
F^i(X(t)|X(t-1)) &= \int_0^\Delta f^i(X(t)|X(t-1))e^{-\lambda s}ds \\
&= \frac{1-e^{-\lambda\Delta}}{\lambda} \times [z(1-\alpha)(1 - \frac{X(t) - e^{-\eta\Delta}X(t-1)}{K}] \\
&= \gamma_1(z,\alpha) - \gamma_2(z,\alpha) \times [X(t) - e^{-\eta\Delta}X(t-1)]
\end{aligned}
$$

where $\gamma_1(z,\alpha) = \dfrac{1-e^{-\lambda\Delta}}{\lambda} \times z(1-\alpha)$ and $\gamma_2(z,\alpha) = \dfrac{1-e^{-\lambda\Delta}}{\lambda} \times \dfrac{z(1-\alpha)}{K}$

Since $F^i(X(t)|X(t-1))$ is the total value the citizens receive for per unit of $X(t)$ in the stage game, it can be seen as the "price" of the stock of the punishment. Let

$$P^i(X(t)|X(t-1)) = F^i(X(t)|X(t-1)) = \gamma_1(z,\alpha) - \gamma_2(z,\alpha) \times [X(t) - e^{-\eta\Delta}X(t-1)].$$

Assumption 2: Forward Looking Players

The assumption of being forward looking implies two effects. First, players only care about the payoff relevant history rather than the ex post history. This means both the government and the citizens have incentives to go beyond the punishment strategies and "let bygones be bygones" (Maskin and Tirole, 2001). Second, players are aware that their actions will affect the future path of the game and future expectations of their opponents.

The assumption of forward looking players implies we can exclude many Subgame Perfect Equilibria (SPEs) with punishment properties from the SPEs sets. In addition, if there exists a Markov strategy profile which is a SPE, then this Markov strategy consists of a Markov Perfect equilibrium (MPE). The strategy profile σ is a Markov strategy profile if for any two ex post histories $\tilde{h}^t$ and $\tilde{h}^\tau$ terminating in the same state, $\sigma(\tilde{h}^t) = \sigma(\tilde{h}^\tau)$. A Markov strategy profile is a stationary MPE if it is time irrelevant or a non-stationary MPE if it is time dependent.

Loosely speaking, in a dynamic game MPEs are Subgame Perfect Equilibria (SPEs) that are not supported by "history-dependent punishment strategies." So MPEs are the refinement of SPEs and when there is no room for those "history-dependent punishment strategies" in the SPEs, SPEs will coincide with the MPEs (Acemoglu, 2006). The advantages of MPE are the intuition that only payoff relevant variables should matter in shaping players' strategies (Mailath and Samuelson, 2006). In an authoritarian regime like China, once a protest happens, the cost to the protestors is usually durable and high. So in the game with the government, the citizens do have incentives to go beyond the punishment strategies and focus on the state variable(s) and future payoffs. Similarly, the government does not have to pay much cost to punish the protestors since the punishment has been institutionalized as discussed in the previous section. With this initial condition, the government certainly has incentives to focus on the payoff relevant variables as well. Thus a Markov strategy makes more sense in the dynamic state-society relationship in the CCP regime.

3.2 Stationary Markov Perfect Equilibrium

The citizens' benefit maximization problem, in any period t, is to choose the sequence of protesting level $\{X(t), X(t+1), X(t+2),...,\}$ to maximize

$$V(X(t), t|X(t-1)) = \sum_{\tau=t}^{+\infty}(X(\tau) - X(\tau-1)e^{-\eta\Delta}) \times [P^i(X(\tau)|X(\tau-1)) - MC^j(X(\tau), \tau)] \times e^{-\lambda\Delta(\tau-t)}$$

$$= \sum_{\tau=t}^{+\infty}(X(\tau) - X(\tau-1)e^{-\eta\Delta}) \times \{\gamma_1(z, \alpha) - \gamma_2(z, \alpha) \times [X(\tau) - e^{-\eta\Delta}X(\tau-1)]$$

$$- \sum_{l=0}^{+\infty}e^{-(\lambda+\eta)\Delta l} \times \beta(\lambda, \eta, \Delta)X(\tau+l)\} \times e^{-\lambda\Delta(\tau-t)}$$

The state variable in period t is obviously $X(t-1)$ which is the stock of the punishment chosen by the citizens in the previous period. Suppose the citizens' action and thus the government's expectation on $X(t)$ is $X(t) = g(X(t-1))$. Then the citizens' strategy in any period since t is supposed to be a function of $X(t-1)$. To build into the description of the Markov strategy, let $g(s, t, X)$ be a more flexible description of the citizens' strategy (Mailath and Samuelson, 2006) which identifies the stock cost in the period s given that the stock cost in period $t \le s$ is X. In a stationary Markov strategy, if the game is approaching the same state no matter how and when it is reached, then the citizens are expected to make the same action. Thus the following consistent conditions are needed to build a stationary MPE. $g(s', t, X) = g(s', s, g(s, t, X))$ for $s' \ge s \ge t$ and $g(s+\tau, s, X) = g(t+\tau, t, X)$ for $s \ne t$.

Since I am interested in the evolution of the social stability in the CCP regime, following Stokey (1981), I assume $g(s, t, X)$ has the form of $g(s, t, X) = X^* + \mu^{(s-t)}(X - X^*)$, where X^* is interpreted as the limiting stock of punishment the citizens would like to reach and μ ($0 \le \mu < 1$) is the speed of adjustment to this limit.

In a stationary MPE, there are three possible equilibrium paths of social stability. First consider $0 < \mu < 1$ and $X(0) < X^*$. On this path, the level of protests keeps going up until $R^* = \dfrac{\gamma_1(z, \alpha)(1 - e^{-\eta\Delta})(1 - e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta} - \mu)}{K e^{-\eta\Delta} \beta(\lambda, \eta, \Delta)(1 - \mu)}$ is reached. Define this equilibrium path of social stability as the transition path and $X_T^* = X^*$ stands for the limiting stock of the punishment on this transition path. Second, if $0 < \mu < 1$ and $X(0) > X^*$ then the level of social unrests decreases and converges to R^*. Last, if $\mu = 0$ then in this situation, the citizens would like to commit themselves to setting $X(t) = X_S^*(\eta, z, \alpha)$ for all t where $X_S^*(\eta, z, \alpha) < X_T^*$. Define this equilibrium path of social stability as the stable path.

The divergence in equilibrium paths is caused by initial conditions, $X(0)$, and the values of the parameters η, z, and α. (1) If $X(0)$ is a small number which implies the protest level is at a low level and η is very large which implies the punishment constraints are loose, then the citizens have incentives to escalate social unrest levels. This is the case of the transition path. (2) If η or z (or α) is small (large) enough, then the citizens would like to commit themselves to setting $X(t) = X_S^*(\eta, z, \alpha)$ for all t where $X_S^*(\eta, z, \alpha) < X_T^*$. This is the case of the stable path (type I). If the citizens insist on this stable path, then the existence of this path implies the optimal protesting level is supposed to be closer to $X_S^*(\eta, z, \alpha)$ than X_T^*. (3) If $X(0)$ is a big number which implies the protest level is at a high level and η is very small which implies the punishment constraints are tight, then the citizens have incentives to shrink social unrest level. This is another case of the stable path (type II) and the Chinese social stability in 1950s represents this type (as we can see in Figure 1 later). To conduct a more general comparison of the social stability between a central planning economy and a transition economy, I will concentrate on the first two paths in the following analysis.

Empirically, Chinese state-society relations have experienced a transition path since reform and the number of the protests grows rapidly. In the stationary model, this can be explained by a small $X(0)$ and a very large $X_T^* = X^*$. The citizens' expectation on X_T^* is influenced by the three key parameters discussed in section 2. The following proposition generalizes the relationship between X_T^* and these variables. Graphically, the different patterns of social stability in China's two development stages can be summarized in Figure 1. X-axis indicates the time line and Y-axis denotes the level of unrests. The transition path is what happened in China since the 1990s. The stable path II describes the state-society relations in the Mao era since the early 1950s. The stable path I is a more general case of the social stability in a central planning economy.

Proposition 1. The limiting level of social unrests on the transition path is negatively correlated with the policy efficiency parameter α and durable cost parameter η, but positively correlated with the distributable income index z. i.e., for $\forall \alpha \in (0, 1)$ and

$\eta \in (0, +\infty)$, $\dfrac{dR^*}{d\alpha} < 0$, $\dfrac{dR^*}{d\eta} < 0$ and $\dfrac{dR^*}{dz} > 0$.

Based on Proposition 1, it is easy to understand the stable path may be maintained as long as one or more of the three key parameters can prevent the citizens from escalating the level of protests. For example, if the policy efficiency α is close to 1, then the benefit of coming out on the street is close to 0. Given that the cost of protests is fixed, the citizens may minimize the protest level in each stage game. Just as discussed in section 2, these three variables have been changed greatly since reform. The Proposition 2 takes the durable cost parameter η as an example to demonstrate the conditions in which a central planning economy can maintain its social stability while an increasing number of protests are expected in a market-oriented transition economy.

Figure 1. The Stationary Equilibrium Paths of Social Stability—

**A Comparison Before and After Reform**
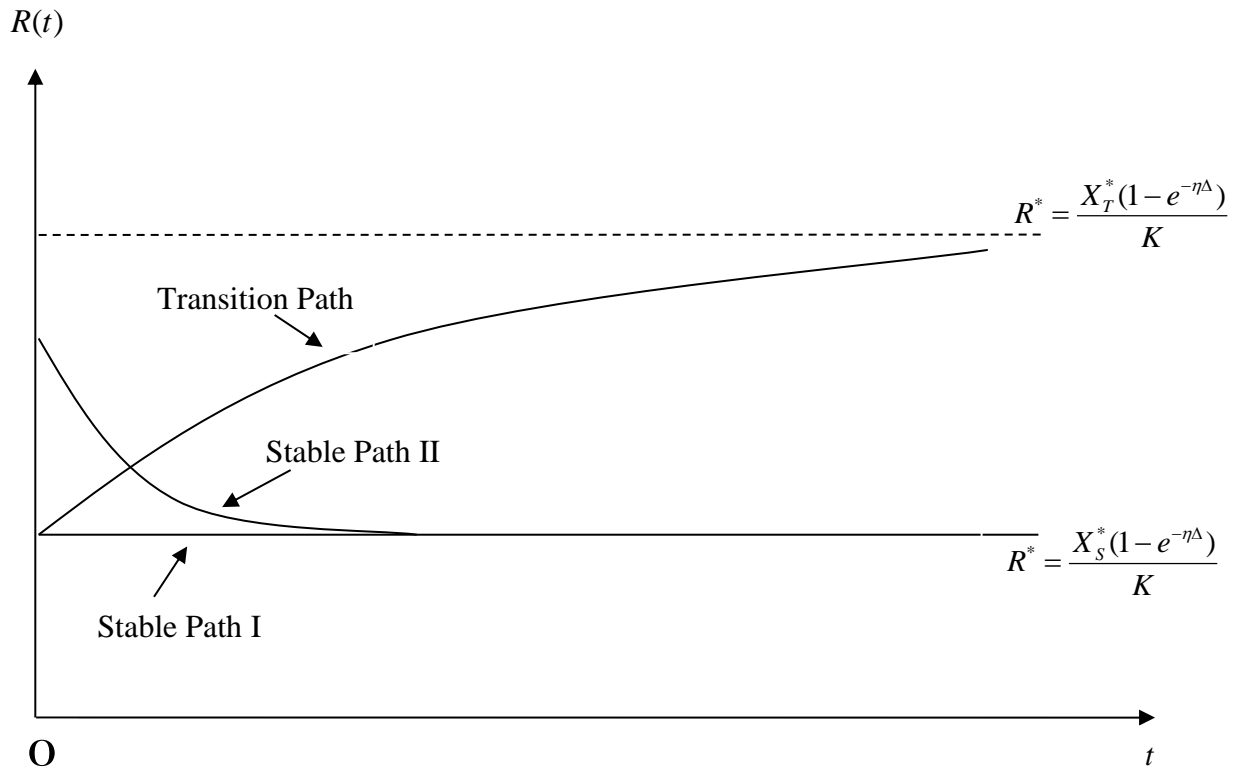
Proposition 2. In the CCP regime, as long as the parameter of the durable cost η is small enough, the citizens would prefer to stay on the stable path rather than on the transition path. Mathematically, for every $z > 0$ and $\alpha \in (0,1)$, there exists a $\eta(z, \alpha) > 0$ such that
$$\forall \eta \in (0, \eta(z, \alpha)) \implies V(X_S^*(\eta, z, \alpha)) > V(X(t), t | X(t-1)).$$

Figure 2 simply shows if an increasing η is a byproduct of the economic reform then more protests are expected during the reform, other things being equal. Mathematically, z performs a reverse function as α does, but it certainly has very

different meanings in politics. A large z implies the success of economic reform while a small α means the inefficiency of the CCP regime.

Figure 2. **Durable Cost, Distributable Income, Policy Efficiency and the Level of Social Stability**

$(z_2 < z_1)$

$R^*(\eta | z, \alpha)$
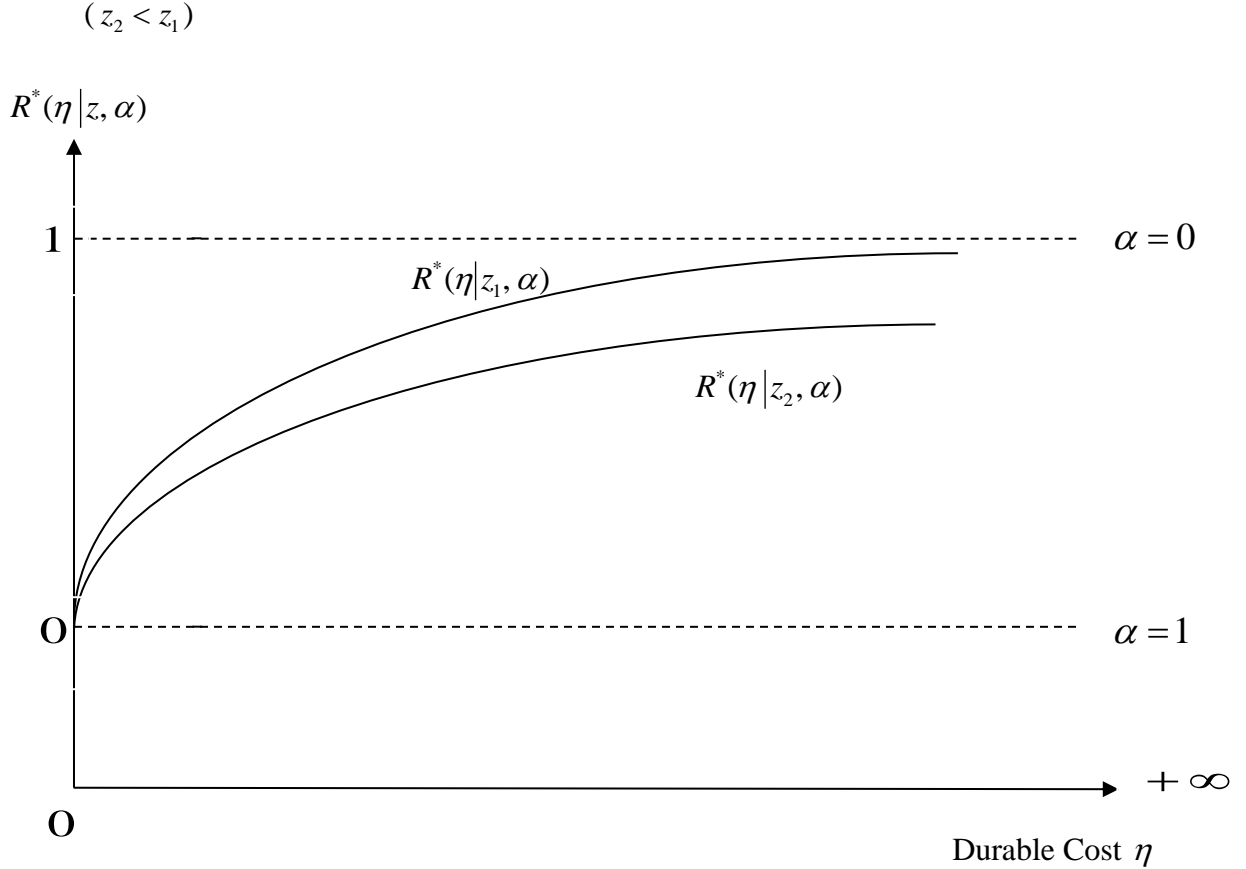
Chinese history has a record of resistance and revolt second to none (Perry and Selden, 2003). The CCP regime in the Mao era remained extremely stable even in the Great Famine of 1959-1961. The following Corollary contends the capability of a central planning economy in dealing with economic crisis.

Corollary 1. Assume that $\underline{V}$ is the value of a revolt to the citizens and a one-time external shock in time period t makes $z(t) = 0$. For every $z(t) \geq 0$, $0 < \underline{V} \leq V(X_T^*)$ and a limited number of external shocks $0 \leq N < +\infty$, [10] there exists a $\eta(z, \alpha) > 0$ and $\Delta(\underline{V}, N) > 0$ such that

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[10] Assume the external shocks are independent from each other.

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$$\forall \eta \in (0, \eta(z, \alpha)) \text{ and } \forall \Delta \in (0, \Delta(\underline{V}, N)) \implies V(X_S^*(\eta, z, \alpha), N) > \underline{V}.$$

Corollary 1 implies the following statement. Assume an external shock has one time impact on the distributable income; and the payoff of following a transition path is greater than that of a revolt. So a strict punishment η ensures the citizens will not jump onto the transition path and the "rent" for escalating the level of protests does not exist. However, since the citizens have a choice of rebellion, a small η cannot make sure that the status quo must be more beneficial to the citizens. Let Δ, the length of each stage game, represents the frequency or the speed of the government's response to the citizens' action. If the central government is able to change its policy quickly through a centralized bureaucratic and economic system, then the citizens' expectation on the continuation of crisis is disrupted. As long as Δ is small enough, to keep status quo is more beneficial to the citizens.

In the previous discussion, I have demonstrated why the CCP can maintain the social stability in the Mao era and how the uprising protests emerged since the reform. Accompanied by the rapid economic growth, η has been irreversibly increasing and z has become larger and larger. Thus an efficient way to keep the social stability is to increase the policy efficiency parameter α.

Proposition 3. For any $0 < \eta_1 < \eta_2 < +\infty$, $\alpha_1 \in (0, 1)$ and $R^*(\alpha_1, \eta_1) \in (0, 1)$ there exists a $\alpha_2(\eta_2, R^*(\alpha_1, \eta_1)) \in (\alpha_1, 1)$ such that

$$\forall \alpha \in (\alpha_2(\eta_2, R^*(\alpha_1, \eta_1)), 1) \implies R^*(\alpha, \eta_2) < R^*(\alpha_1, \eta_1)$$

Proposition 3 shows if a central authoritarian regime is unable to enforce a hard punishment to the citizens any more, then there always exists a policy efficiency space. As long as the central policy can be delivered to the grassroots within this space, the social stability is still expected to be maintained.

Corollary 2. To maintain the level of social stability, the policy efficiency elasticity of distributable income on social stability is $\dfrac{\alpha}{1 - \alpha}$.

Based on the assumption that the policy efficiency α is independent from distributable income parameter z, Corollary 2 identifies a condition that the level of protests keeps unchanged given that the distributable income grows rapidly. The implications of Corollary 2 and Proposition 3 are very similar. Both of them highlight the importance of policy efficiency in a transition economy.

Proposition 4. If the policy efficiency α is positively correlated with distributable income parameter z, and the correlation coefficient is larger than the policy efficiency elasticity of distributable income on social stability (identified in Corollary 2), then as long as z is large enough, the social stability can be well maintained. Mathematically, assume $\dfrac{d\alpha}{dz} > \dfrac{1 - \alpha}{z}$, then for any $0 < \eta_1 < \eta_2 < +\infty$, $\alpha_1 \in (0, 1)$ and $R^*(\alpha_1, \eta_1 | z_1) \in (0, 1)$ there exists a $z(\eta_2, R^*(\alpha_1, \eta_1 | z_1)) < +\infty$ such that

$$\forall z \in (z(\eta_2, R^*(\alpha_1, \eta_1|z_1)), +\infty) \quad \Rightarrow \quad R^*(\alpha(z), \eta_2|z) < R^*(\alpha_1, \eta_1|z_1).$$

The independent relation between the policy efficiency α and distributable income parameter z is highly likely valid in a central planning economy. In a rapidly growing market economy (an increasing z), however, the local governments hold more and more economic power during the decentralization reforms such as the dual track price reform in 1980s and the SOE reform in 1990s. As a result, α becomes smaller and smaller as China's reform goes deep. Certainly, the early stage tradeoffs between the economic growth and policy efficiency do not necessarily mean the center has nothing to do with it. Since the global financial crisis the central government has shown its power after throwing RMB-4,000-billion economic stimulus package in the country. Therefore it is more likely the center will be able to re-strengthen its authority again as the country's economy continues growing. Proposition 4 predicts the potential development of social stability if the central authority is re-strengthened. In short, in a transition economy like China the relationship between α and z may be more complicated in the dynamic reform process.[11]

3.3 Non-Stationary Markov Perfect Equilibrium

In the previous stationary analysis, the players' Markov strategy is assumed to be time irrelevant. In China's economic transition process, however, these key parameters such as the policy efficiency α, durable cost parameter η and distributable income index z which we have emphasized frequently may change with time. As we can see from Proposition 2, if $\dfrac{d\eta(t)}{dt} > 0$, then it is possible at some time period t the citizens will jump onto the transition path rather than stay on the stable path all the way. This implies if some parameters change with time, then the citizens' strategy and thus the MPE might be time relevant as well. In other words, a non-stationary MPE may emerge.

In the Mao era since the central government's primary goal is to push the heavy industry and the various institutions are comparatively stable, α, η and z may not change greatly over time. So let's assume α, η and z are still time irrelevant and the citizens remain on the stable path in the central planning economy.[12] Since the economic reform, however, as what have been discussed in section 1 and 2, we do have evidence that η and z have been enlarged over time and α become smaller and smaller in the mean time. In addition, the changes of these three parameters play a similar role in determining the outcome of social stability. Thus I just focus on $\eta(t)$ and assume the other two variables are time irrelevant temporarily. Before moving to Proposition 5 and explain how the citizens jump from the stable path onto the transition path, first consider

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[11] Empirical data shows that "as authoritarian regimes are more institutionalized, it is expected that social spending will increase, reflecting policy compromises with social groups." See Gandhi(2008), p133.

[12] It's more likely that α, η were strengthened by the central government in the Mao era along with the economic growth even though z was increased a bit.

the citizens' strategy and thus the central government's expectation on $X(t)$ takes the following form:

$$g(t, s, X) = \begin{cases} X(t) & \text{if} \quad t = s \\ X_S^*(\eta, z, \alpha) & \text{if} \quad X_s \leq X_S^*(\eta, z, \alpha); t > s \ ^{13} \\ X_T^* + \mu^{(s-t)}(X(t) - X_T^*) & \text{if} \quad X_s > X_S^*(\eta, z, \alpha); t > s \end{cases}$$

where $X_S^*(\eta, z, \alpha)$ is the solution derived from the previous stationary model when the citizens follow a stable path, X_T^* and μ are the solutions if the citizens follow a transition path. In the stationary game, Proposition 2 has identified the condition for $\eta(t)$ to keep the citizens on the stable path. In the non-stationary game, if $\frac{d\eta(t)}{dt} > 0$ and $\eta(t)$ is large enough at some time point, then the citizens certainly have incentives to jump onto the transition path. Lemma 1 demonstrates this point of view.

Lemma 1. Assume $\frac{d\eta(t)}{dt} > 0$. For every $z > 0$ and $\alpha \in (0, 1)$, there exists a $\eta(z, \alpha) > 0$

and $t^* < +\infty$ such that $\forall t > t^*$ and $\eta(t) \in (\eta(z, \alpha), +\infty)$

$\Rightarrow \quad V(X_S^*(\eta(t), z, \alpha)) < V(X(t), t | X(t-1))$

Based on Lemma1, the following Proposition 5 demonstrates why an increasing number of protests have been observed since the reform.

Proposition 5. Assume when a country is transforming from a central planning economy to a market economy, the punishment rate, η, keeps going up. Specifically, let $\eta(t) = \eta_0 e^{\psi t}$ where $\eta_0 > 0$ and η_0 satisfies $\eta_0 < \eta(z, \alpha)$ which is required by Lemma 1. Then there exists a $\psi(\eta_0 | z, \alpha) > 0$ and a crucial time point $t(\psi, \eta_0 | z, \alpha) > 0$ such that

$$g(s, t, X) = \begin{cases} X_S^*(\eta_0, z, \alpha) & \text{if} \quad s \leq t(\psi, \eta_0 | z, \alpha) \\ X_T^* + \mu^{(s-t)}(X(t) - X_T^*) & \text{if} \quad s > t(\psi, \eta_0 | z, \alpha) \end{cases}$$

Proposition 5 implies if the rapid economic growth is accompanied with the greatly reduced cost to the protestors (or the heavily weakened central authority or both), then the citizens do have incentive to jump onto the transition path in which the level of social unrests keeps going up until the limiting of the unrest level is approached. Figure 3 describes the main findings in a non-stationary MPE game. X-axis indicates the time line. Since t is highly correlated with the annual growth rate on average, it can be viewed as the process of the reform or socialist construction as well. Y-axis denotes the level of social unrests. t^* is the time point when the citizens decide to move onto the transition

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[13] And assume the game starts in a central planning economy, so $X(0) \leq X_S^*(\eta, z, \alpha)$

path. In Mao's regime, since α, η and z are still time irrelevant and the various institutions are comparatively stable, thus the level of protests was kept at a low level with a slope close to 0 in Figure 3. While during the reform, t^* is the point of Deng Xiaoping's south tour which declared the beginning of the explosive reforms such as the large-scale privatization of SOEs. Since these reforms released social control and weakened the central authority, as Proposition 5 contends, the citizens left the stable path and jumped onto the transition path in which the level of mass incidents keeps increasing.

Figure 3. The Non-Stationary Equilibrium Paths of Social Stability—

A Comparison Before and After Reform
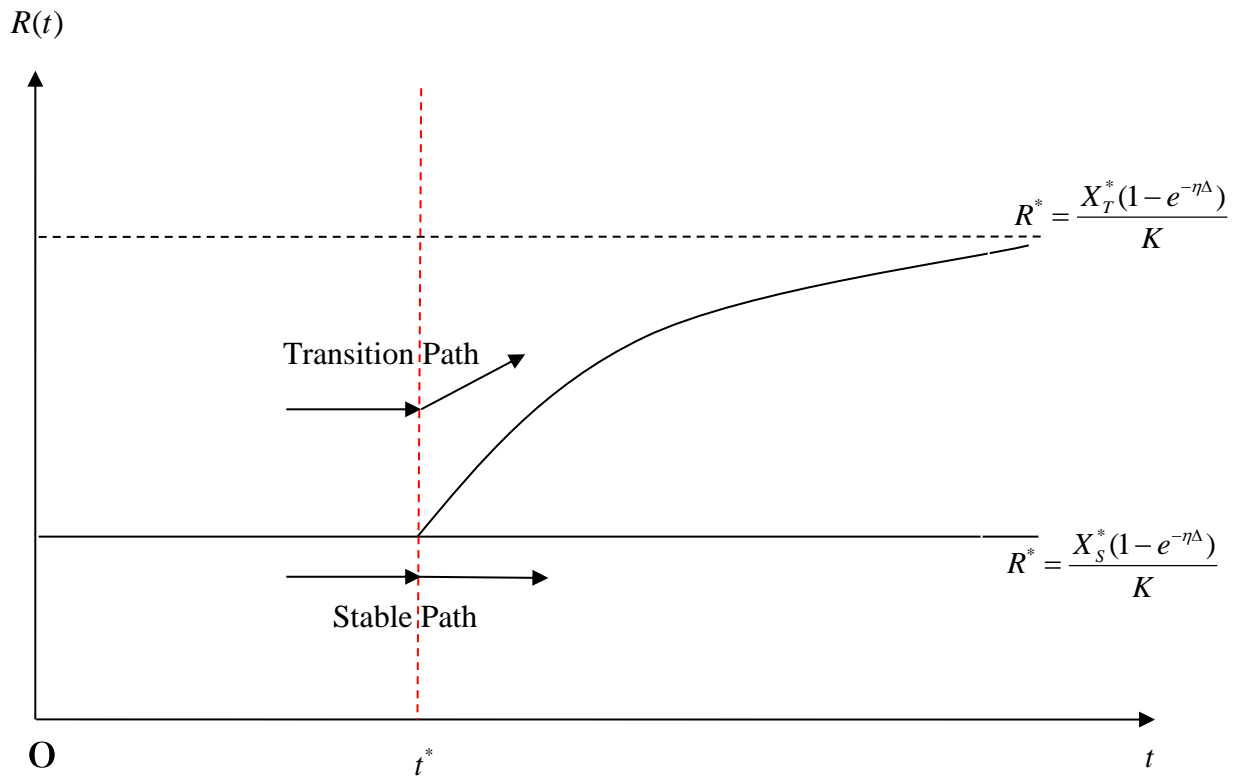
The last concern in this paper is whether the CCP will be able to improve its state-society relations in the future. As China's economic reform goes on, the durable cost parameter η and the distributable income parameter z cannot help the central government improve the state-society relations. Potentially the most efficient way for the central government to build a stable society in the reform is to increase α.[14] The

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[14] O'Brien and Li (2006) argue that as long as there is a gap between what is promised and what is actually delivered by the government, there is a room for rightful resistance. This implies α might be a large number in the early stage of transition.

condition that the CCP regime can improve its state-society relations is indentified in the following Proposition 6.

Proposition 6. Assume in a central planning economy, the efficiency factor is a constant $\alpha(t) = \alpha_C$ for every t thus it is independent from $z(t)$. i.e., $\dfrac{d\alpha(t)}{dz(t)} = 0$. In a transition economy, however, the relationship between α and z gets more complicated. Suppose $\dfrac{d^2\alpha(t)}{dz^2(t)} > 0$ for every $\alpha(t) \in (0,1)$ in a market-oriented central autocratic system and there exists a $z^* \in (z_0, +\infty)$ satisfying $\dfrac{d\alpha(t)}{dz(t)}\Big|_{z=z^*} = \dfrac{1-\alpha(t)}{z(t)}$. Then there exists a $z(\alpha) < +\infty$ such that $\forall z(t) \in (0, z(\alpha)) \implies \dfrac{dR^*}{dt} > 0$ and $\forall z(t) \in (z(\alpha), +\infty) \implies \dfrac{dR^*}{dt} < 0$

Figure 4 demonstrates the implication of Proposition 6 and represents a potential development of the mass movements in the CCP regime. X-axis and Y-axis indicate the time period and the level of social unrest, respectively. Since the policy efficiency parameter α is assumed to be a constant and independent from the growth of distributable income z in the Mao era, the slope of the social unrest path $R(t)$ only increases slightly corresponding to the economic performance. In China's transition process, however, the relationship between α and z is more complicated. If $\dfrac{d^2\alpha(t)}{dz^2(t)} > 0$ just as assumed in Proposition 6, then the social stability since reform is expected to experience three phases and its pattern looks like an inverted "U" curve. In the first phase, the central government loses its super authority and a sharp increase of social unrests is observed due to the decentralization reforms. In the second phase as the country's economy continues growing, there is an inflection point after which the center will be able to re-centralize its power and the social stability is expected to keep going down since then. The last phase demonstrates if the central government continues succeeding in both economic performance and policy delivery, then a very stable society is predicted.

Figure 4. Distributable Income, Policy Efficiency, and the Level of Social Unrest

Unrest Level R^*
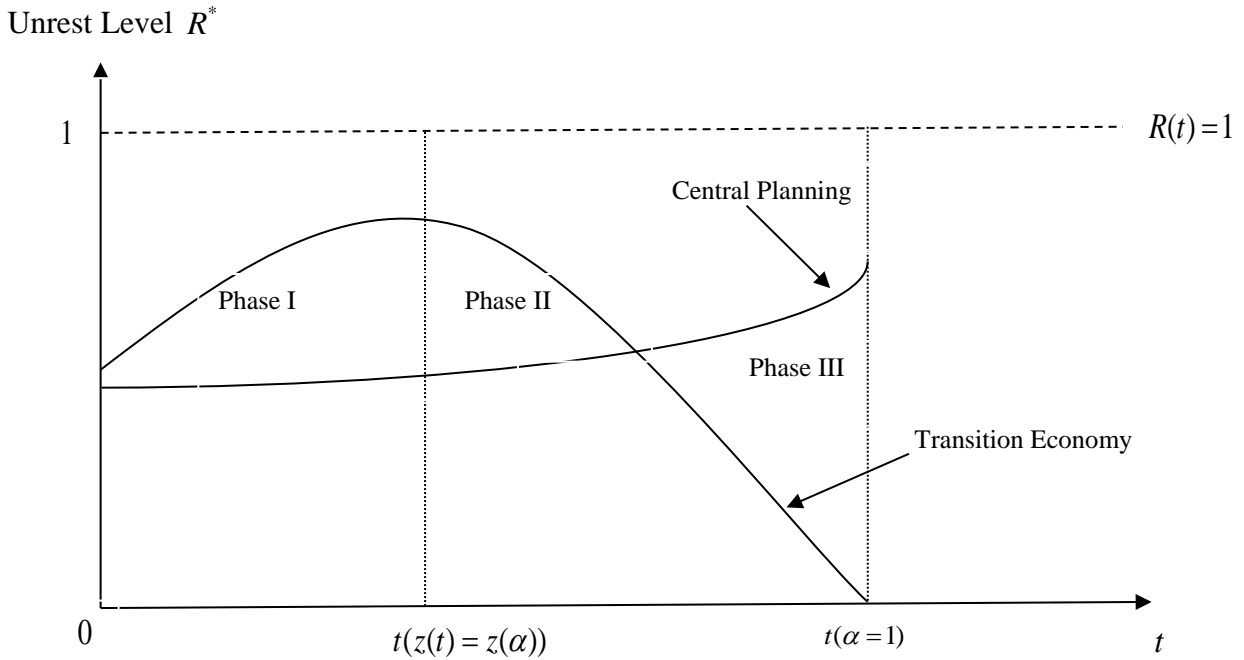
4. Discussion and Policy Implications

Both stationary and non-stationary MPEs can well explain the distinct patterns of social stability in the two development stages of the CCP regime in the model. The mass incidents are constrained on the stable path in which the citizens generally only show their loyalty to the central government—this is what happened during the central planning period. On the transition path, more and more social unrests are predicted despite rapid economic growth—this is what happened during China's economic reform.

The dynamic model presented in this paper is based on a major assumption that both central government and citizens are forward looking players and they pay much attention to the payoff relevant variables rather than what the other side did in the history. [15] Thus Markov perfect equilibrium is applied to explain the dynamic state-society relationship in the CCP regime. The citizens do have intuitive to focus on their payoff in a protesting game with the strong government. The government is forward looking as well because the durable cost to the citizens is enforced by exogenous institutions.

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[15] "They may remember yesterday, but they forget the day before." –Edwin W. Kemmerer. "This was the comment made by Professor E. W. Kemmerer when he was asked by the Senate in 1931 whether the crass mistakes made by business which had brought on the great depression would be remembered by the people." See Finer (1945).

There are three features associated with the set up of this dynamic model. First, based on the forward looking assumption, the government's behavior in the model setup is simplified as offering a price to match a certain level of collective incidents. Therefore the inverse demand curve reflects the government's expectation on the citizens' strategies. Second, with the exogenous institutions fixed, it is reasonable to assume the level of protests is supposed to converge to its limiting. So the speed of adjustment to the limiting maximizes the citizens' benefits. Third, for simplicity, the local governments do not emerge in the model, but their influences on the state-society relationship have been included in the parameter α.

A distinct difference between this model and other perspectives in the literature is that the model does not focus on using a single variable to explain the social stability. Rather, the state-society relationship in the CCP regime is viewed as a tendency or process determined by the interaction of variables in the central planning economy and the transitional institutions. For instance, during the Anti-Rightist Movement before the Great-Leap Forward, the durable punishment parameter η had been reduced greatly. After the Great-Leap Forward, the center made quick policy adjustments to strengthen the central planning economy which implies Δ, the length of the stage game, had been shortened. Consequently, the natural disasters and the policy disasters had little shock on the regime stability during the Great Famine—this is implied by Corollary 1. This finding is in sharp contrast to the large scale peasants' revolt associated with the economic crisis in the Chinese history. Also, the tendency of social stability during the transition process is still shaped by the interaction of variables. As we can see in Figure 3 and Proposition 5, the market-oriented reform starts from a central planning economy stage in which η is small enough to ensure that the citizens follow the stable path temporarily. As the market economic reforms go into depth, three consequences will emerge gradually: (1) the durable punishment parameter η has been enlarged since the private ownership accounts for an increasingly large percent of national economy; (2) the distributable income parameter z gets bigger and bigger as the national economy continues performing reasonably well; (3) the policy efficiency parameter α becomes smaller and smaller as the economic reform is decentralized and the corruption becomes proliferated over time. As a result, the citizens will finally jump from the initial stable path to the transition path. This is why an increasing number of collective incidents have been observed despite the good economic performance since 1990s.

There are two weaknesses in the setup of the dynamic model. First, the citizens are assumed to be identical cross the long period and the regions. So, although the model can well generalize the patterns of social stability, it cannot distinguish the different categories of the mass incidents. Second, the model predicts the policy efficiency parameter α will rebound after hitting rock bottom thus the level of collective protests is expected to go down as China's economy continues growing rapidly. This prediction certainly needs to be tested in the future.

The model has two important policy implications. One, to maintain the social stability, the central government is supposed to try every best to constrain its local agents' behavior and strengthen the central authority. According to Proposition 1 and 6, the growth of economy usually inspires the social movements. Unless the continued economic growth has a positive impact on the policy efficiency, the level of collective

incidents will not go down. Two, the center is supposed to make a quick adjustment to the wrong policy and a quick response to various mass incidents. Corollary 1 and the lesson of the Great Famine imply if the central government can make a quick reply to a collective action or a wrong policy, then the citizens do have intuition to restrain themselves from escalating social unrests or rebellion. This finding corresponds to Bar-El's argument: "threats to the security of dictatorial regimes are shown to be a means of benefiting the population through the responses of the regime." (Bar-El, 2009).

5. Conclusion

China's state-society relationship has experienced two distinct stages. During the command economy period, the central government implemented a heavy industry priority development strategy and the citizens' living condition was maintained at a very low level. The central government, however, was able to keep very stable state-society relations in the Great-Leap Forward, the "Great Famine" and the Culture Revolution. Starting from the end of 1970s, though people's well being has been improved greatly during the market-oriented reform, the Chinese society seems to become more and more instable especially since 1990s.

This paper employs the concept of Markov perfect equilibrium and explains the paradox between the economic development and social stability in the CCP regime. In a central planning economy, I contend the government policy efficiency is independent from the economic growth and very few collective incidents are predicted by the model even with extreme external shocks such as the Chinese Great Famine of 1959-1962. During the transition period, the policy efficiency has a complicated relationship with economic performance. In both stationary and non-stationary MPEs, the levels of social unrests are positively associated with the economic growth initially. Thus the citizens have incentives to jump from the "stable path" to the "transition path"—that's why an increasing number of collective incidents have been observed.

However, these findings do not necessarily mean China will continue its unstable style in the future. If the center will be able to constrain its local agents' behavior and strengthen the central authority; if the center will be able to respond the mass incidents quickly and resolve the social problems efficiently, then the evolution of China's social stability is expected to experience two stages: in the first stage an increasing number of collective incidents are predicted while in the second stage the state-society relationship will become more and more stable.

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Appendix.

The Stationary MPE

   (1) The transition path

The citizens' benefit maximization problem, in any period t, is to choose the sequence of protesting level $\{X(t), X(t+1), X(t+2),...,\}$ to maximize

$$V(X(t), t|X(t-1)) = \sum_{\tau=t}^{+\infty}(X(\tau) - X(\tau-1)e^{-\eta\Delta}) \times [P^i(X(\tau)|X(\tau-1)) - MC^j(X(\tau), \tau)] \times e^{-\lambda\Delta(\tau-t)}$$

$$= \sum_{\tau=t}^{+\infty}(X(\tau) - X(\tau-1)e^{-\eta\Delta}) \times \{\gamma_1(z, \alpha) - \gamma_2(z, \alpha) \times [X(\tau) - e^{-\eta\Delta}X(\tau-1)]$$

$$- \sum_{l=0}^{+\infty}e^{-(\lambda+\eta)\Delta l} \times \beta(\lambda, \eta, \Delta)X(\tau+l)\} \times e^{-\lambda\Delta(\tau-t)}$$

For $s \geq t \geq 0$, the first order condition (F.O.C.) is:

$$\{[\gamma_1(z, \alpha) - \gamma_2(z, \alpha) \times (1-e^{-\eta\Delta})X^*](1-e^{-(\lambda+\eta)\Delta}) - \beta(\lambda, \eta, \Delta)X^* - (\gamma_2(z, \alpha) + \frac{\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-e^{-\eta\Delta})X^*\}$$

$$+ \{-\gamma_2(z, \alpha) \times (1 - \frac{e^{-\eta\Delta}}{\mu})(1-e^{-(\lambda+\eta)\Delta}) - \beta(\lambda, \eta, \Delta) - (\gamma_2(z, \alpha) + \frac{\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-\frac{e^{-\eta\Delta}}{\mu})\} \times \mu^{(s-t)}(X - X^*) = 0$$

Since this condition must be hold for any $s \geq t$, thus it yields

$$\gamma_2(z, \alpha) \times (1 - \frac{e^{-\eta\Delta}}{\mu})(1-e^{-(\lambda+\eta)\Delta}) + \beta(\lambda, \eta, \Delta) + (\gamma_2(z, \alpha) + \frac{\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-\frac{e^{-\eta\Delta}}{\mu}) = 0$$

and

$$[\gamma_1(z, \alpha) - \gamma_2(z, \alpha) \times (1-e^{-\eta\Delta})X^*](1-e^{-(\lambda+\eta)\Delta}) - \beta(\lambda, \eta, \Delta)X^* - (\gamma_2(z, \alpha) + \frac{\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-e^{-\eta\Delta})X^* = 0$$

Define

$$\Gamma(\mu) = \gamma_2(z, \alpha) \times (1 - \frac{e^{-\eta\Delta}}{\mu})(1-e^{-(\lambda+\eta)\Delta}) + \beta(\lambda, \eta, \Delta) + (\gamma_2(z, \alpha) + \frac{\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-\frac{e^{-\eta\Delta}}{\mu})$$

Since $\Gamma(1) > 0$, $\Gamma(e^{-\eta\Delta}) > 0$, $\Gamma(+\infty) \to -\infty$, $\Gamma(\frac{e^{-\eta\Delta}}{2}) < 0$, there is a unique

solution for μ in $(\frac{e^{-\eta\Delta}}{2}, e^{-\eta\Delta})$ and $\mu^* = \Gamma^{-1}$.

From

$$[\gamma_1(z,\alpha)-\gamma_2(z,\alpha)\times(1-e^{-\eta\Delta})X^*](1-e^{-(\lambda+\eta)\Delta})-\beta(\lambda,\eta,\Delta)X^*-(\gamma_2(z,\alpha)+\frac{\beta(\lambda,\eta,\Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-e^{-\eta\Delta})X^*=0$$

$$\Rightarrow$$

$$X^*=X_T^*=\frac{\gamma_1(z,\alpha)(1-e^{-(\lambda+\eta)\Delta})}{\gamma_2(z,\alpha)\times(1-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta})+\beta(\lambda,\eta,\Delta)+(\gamma_2(z,\alpha)+\frac{\beta(\lambda,\eta,\Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-e^{-\eta\Delta})}$$

$$=\frac{\gamma_1(z,\alpha)(1-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)}{e^{-\eta\Delta}\beta(\lambda,\eta,\Delta)(1-\mu)}$$

Therefore,

$$R(t)=\frac{X(t)-X(t-1)\times e^{-\eta\Delta}}{K}=\frac{X^*+\mu(X(t-1)-X^*)-X(t-1)\times e^{-\eta\Delta}}{K}=\frac{(1-\mu)X^*+(\mu-e^{-\eta\Delta})X(t-1)}{K}$$

and

$$R^*=\lim_{t\to+\infty}R(t)=\lim_{t\to+\infty}\frac{(1-\mu)X^*+(\mu-e^{-\eta\Delta})X(t-1)}{K}=\frac{(1-e^{-\eta\Delta})X^*}{K}=\frac{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)}{Ke^{-\eta\Delta}\beta(\lambda,\eta,\Delta)(1-\mu)}$$

(2) The stable path

Given that $X(t-1)\le X_S^*(\eta,z,\alpha)$, if the citizens follow the stable path, the value of the game from period t and thereafter is going to be:[16]

$$V(X_S^*(\eta,z,\alpha))=\sum_{s=0}^{+\infty}X_S^*(\eta,z,\alpha)(1-e^{-\eta\Delta})\times\{\gamma_1(z,\alpha)-\gamma_2(z,\alpha)\times X_S^*(\eta,z,\alpha)(1-e^{-\eta\Delta})-\frac{\beta(\lambda,\eta,\Delta)X_S^*(\eta,z,\alpha)}{1-e^{-(\lambda+\eta)\Delta}}\}\times e^{-\lambda\Delta s}$$

Since $\dfrac{d^2V(X_S^*(\eta,z,\alpha))}{dX_S^{*2}(\eta,z,\alpha)}<0$ and $\dfrac{dV(X_S^*(\eta,z,\alpha))}{dX_S^*(\eta,z,\alpha)}=0$

$$\Rightarrow X_S^*(\eta,z,\alpha)=\frac{(1-e^{-\eta\Delta})\gamma_1(z,\alpha)}{2(1-e^{-\eta\Delta})^2\gamma_2(z,\alpha)+\frac{2(1-e^{-\eta\Delta})\beta(\lambda,\eta,\Delta)}{1-e^{-(\lambda+\eta)\Delta}}}$$

Proposition 1.

Proof:

(1) $R^*=\dfrac{(1-e^{-\eta\Delta})X^*}{K}=\dfrac{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)}{Ke^{-\eta\Delta}\beta(\lambda,\eta,\Delta)(1-\mu)}\quad\Rightarrow$

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[16] This value certainly does not depend on the identity of t.

$$\frac{dR^*}{d\beta(\lambda,\eta,\Delta)}<0 \quad \Leftrightarrow \quad \frac{dX^*}{d\beta(\lambda,\eta,\Delta)}<0 \quad \Leftrightarrow \quad \frac{d[\dfrac{(e^{-\eta\Delta}-\mu)}{(1-\mu)\beta(\lambda,\eta,\Delta)}]}{d\beta(\lambda,\eta,\Delta)}<0$$

$$\Leftrightarrow \quad \frac{d[\dfrac{(e^{-\eta\Delta}-\mu)}{(1-\mu)}]}{d\beta(\lambda,\eta,\Delta)}\times\frac{1}{\beta(\lambda,\eta,\Delta)}-\frac{(e^{-\eta\Delta}-\mu)}{(1-\mu)}\times\frac{1}{\beta^2(\lambda,\eta,\Delta)}<0$$

$$\Leftrightarrow \quad \frac{(e^{-\eta\Delta}-1)}{(1-\mu)^2\beta(\lambda,\eta,\Delta)}\times\frac{d\mu}{d\beta(\lambda,\eta,\Delta)}-\frac{(e^{-\eta\Delta}-\mu)}{(1-\mu)}\times\frac{1}{\beta^2(\lambda,\eta,\Delta)}<0$$

$$\Leftrightarrow \quad \frac{d\mu}{d\beta_1(\lambda,\eta,\Delta)}>\frac{(1-\mu)(e^{-\eta\Delta}-\mu)}{(e^{-\eta\Delta}-1)\beta(\lambda,\eta,\Delta)}$$

Obviously, $\dfrac{(1-\mu)(e^{-\eta\Delta}-\mu)}{(e^{-\eta\Delta}-1)\beta(\lambda,\eta,\Delta)}<0$

From the first order condition

$$\Gamma(\mu)=\gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})\times(\mu-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta}\mu)+\beta(\lambda,\eta,\Delta)(-e^{-(\lambda+\eta)\Delta}\mu^2+2\mu-e^{-\eta\Delta})=0$$

We have

$$\frac{d\mu}{d\beta(\lambda,\eta,\Delta)}=-\frac{\partial\Gamma/\partial\beta(\lambda,\eta,\Delta)}{\partial\Gamma/\partial\mu}$$

$$=\frac{e^{-(\lambda+\eta)\Delta}\mu^2-2\mu+e^{-\eta\Delta}}{\gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu+e^{-(\lambda+2\eta)\Delta}]+2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)}>0$$

Therefore, $\quad \dfrac{dR^*}{d\beta(\lambda,\eta,\Delta)}<0$

(2) $R^*=\dfrac{(1-e^{-\eta\Delta})X^*}{K}=\dfrac{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)}{Ke^{-\eta\Delta}\beta(\lambda,\eta,\Delta)(1-\mu)} \quad \Rightarrow$

$$\frac{dR^*}{d\alpha}<0 \quad \Leftrightarrow \quad \frac{dX^*}{d\alpha}<0 \quad \Leftrightarrow \quad \frac{d[\dfrac{\gamma_1(z,\alpha)(e^{-\eta\Delta}-\mu)}{(1-\mu)}]}{d\alpha}<0$$

$$\Leftrightarrow \frac{d[\gamma_1(z,\alpha)(e^{-\eta\Delta}-\mu)]}{d\alpha} \times \frac{1}{1-\mu} + \frac{\gamma_1(z,\alpha)(e^{-\eta\Delta}-\mu)}{(1-\mu)^2} \times \frac{d\mu}{d\alpha} < 0$$

$$\Leftrightarrow \frac{1}{1-\mu}[\frac{d\gamma_1(z,\alpha)}{d\alpha} \times (e^{-\eta\Delta}-\mu) - \gamma_1(z,\alpha) \times \frac{d\mu}{d\alpha}] + \frac{\gamma_1(z,\alpha)(e^{-\eta\Delta}-\mu)}{(1-\mu)^2} \times \frac{d\mu}{d\alpha} < 0$$

$$\Leftrightarrow \frac{d\mu}{d\alpha} > \frac{(1-\mu)(e^{-\eta\Delta}-\mu) \times \dfrac{d\gamma_1(z,\alpha)}{d\alpha}}{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})}$$

From the first order condition

$$\Gamma(\mu) = \gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta}) \times (\mu-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta}\mu) + \beta(\lambda,\eta,\Delta)(-e^{-(\lambda+\eta)\Delta}\mu^2 + 2\mu - e^{-\eta\Delta}) = 0$$

We have

$$\frac{d\mu}{d\alpha} = -\frac{\partial\Gamma/\partial\alpha}{\partial\Gamma/\partial\mu} = \frac{(2-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)(1-e^{-(\lambda+\eta)\Delta}\mu) \times \dfrac{d\gamma_2(z,\alpha)}{d\alpha}}{\gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)}$$

So $\dfrac{dR^*}{d\alpha} < 0$ is equivalent to

$$\frac{(2-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)(1-e^{-(\lambda+\eta)\Delta}\mu) \times \dfrac{d\gamma_2(z,\alpha)}{d\alpha}}{\gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} > \frac{(1-\mu)(e^{-\eta\Delta}-\mu) \times \dfrac{d\gamma_1(z,\alpha)}{d\alpha}}{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})}$$

$$\Leftrightarrow$$

$$\frac{(2-e^{-(\lambda+\eta)\Delta})(1-e^{-(\lambda+\eta)\Delta}\mu) \times \gamma_2(z,\alpha)}{\gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} < \frac{(1-\mu)}{(1-e^{-\eta\Delta})}$$

Let

$$f(\mu) = (2-e^{-(\lambda+\eta)\Delta})(1-e^{-(\lambda+\eta)\Delta}\mu)\gamma_2(z,\alpha)$$
$$- \gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] - 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)$$

$$f'(\mu) = -e^{-(\lambda+\eta)\Delta}(2-e^{-(\lambda+\eta)\Delta})\gamma_2(z,\alpha) + 2e^{-(\lambda+\eta)\Delta}\gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta}) + 2e^{-(\lambda+\eta)\Delta}\beta(\lambda,\eta,\Delta) > 0$$

$$f_{max}(\mu) = \lim_{\mu \to e^{-\eta\Delta}} f(\mu) = -2(1-e^{-(\lambda+2\eta)\Delta})\beta(\lambda,\eta,\Delta) < 0$$

Therefore,

$$\frac{(2-e^{-(\lambda+\eta)\Delta})(1-e^{-(\lambda+\eta)\Delta}\mu) \times \gamma_2(z,\alpha)}{\gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} < 1 < \frac{(1-\mu)}{(1-e^{-\eta\Delta})}$$

i.e., $\dfrac{dR^*}{d\alpha} > 0$.

(3) $R^* = \dfrac{(1-e^{-\eta\Delta})X^*}{K} = \dfrac{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)}{Ke^{-\eta\Delta}\beta(\lambda,\eta,\Delta)(1-\mu)}$ $\Rightarrow$

$\dfrac{dR^*}{dz} > 0 \quad \Leftrightarrow \quad \dfrac{dX^*}{dz} > 0 \quad \Leftrightarrow \quad \dfrac{d[\dfrac{\gamma_1(z,\alpha)(e^{-\eta\Delta}-\mu)}{(1-\mu)}]}{dz} > 0$

$\Leftrightarrow \gamma_1(z,\alpha)[\dfrac{d[(e^{-\eta\Delta}-\mu)]}{dz}\times\dfrac{1}{1-\mu} + \dfrac{(e^{-\eta\Delta}-\mu)}{(1-\mu)^2}\times\dfrac{d\mu}{dz}] + \dfrac{(e^{-\eta\Delta}-\mu)}{(1-\mu)}\times\dfrac{d\gamma_1(z,\alpha)}{dz} > 0$

$\Leftrightarrow \dfrac{d\mu}{dz} < \dfrac{(e^{-\eta\Delta}-\mu)(1-\mu)\times\dfrac{d\gamma_1(z,\alpha)}{dz}}{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})}$

From the first order condition

$\Gamma(\mu) = \gamma_2(z,\alpha)(2-e^{-(\lambda+\eta)\Delta})\times(\mu-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta}\mu) + \beta(\lambda,\eta,\Delta)(-e^{-(\lambda+\eta)\Delta}\mu^2 + 2\mu - e^{-\eta\Delta}) = 0$

We have

$\dfrac{d\mu}{dz} = -\dfrac{\partial\Gamma/\partial z}{\partial\Gamma/\partial\mu} = \dfrac{(2-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)(1-e^{-(\lambda+\eta)\Delta}\mu)\times\dfrac{d\gamma_2(z,\alpha)}{dz}}{\gamma_2(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu+e^{-(\lambda+2\eta)\Delta}] + 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)}$

So $\dfrac{dR^*}{dz} > 0$ is equivalent to

$\dfrac{(2-e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta}-\mu)(1-e^{-(\lambda+\eta)\Delta}\mu)\times\dfrac{d\gamma_2(z,\alpha)}{dz}}{\gamma_2(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu+e^{-(\lambda+2\eta)\Delta}] + 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} < \dfrac{(e^{-\eta\Delta}-\mu)(1-\mu)\times\dfrac{d\gamma_1(z,\alpha)}{dz}}{\gamma_1(z,\alpha)(1-e^{-\eta\Delta})}$

$\Leftrightarrow$

$\dfrac{(2-e^{-(\lambda+\eta)\Delta})(1-e^{-(\lambda+\eta)\Delta}\mu)\times\gamma_2(z,\alpha)}{\gamma_2(2-e^{-(\lambda+\eta)\Delta})[1-2e^{-(\lambda+\eta)\Delta}\mu+e^{-(\lambda+2\eta)\Delta}] + 2(1-e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} < \dfrac{(1-\mu)}{(1-e^{-\eta\Delta})}$

This has been done in part (2). So $\dfrac{dR^*}{dz} > 0$.

Proposition 2.

Proof:

First notice for any η satisfying:

$$X_S^*(\eta, z, \alpha) = \frac{(1-e^{-\eta\Delta})\gamma_1(z, \alpha)}{2(1-e^{-\eta\Delta})^2\gamma_2(z, \alpha) + \dfrac{2(1-e^{-\eta\Delta})\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}} < X_T^*$$

$$V(X_S^*(\eta, z, \alpha)) > V(X(t), t|X(t-1)).$$

To see this, assume for any η satisfying the above condition, $V(X_S^*(\eta, z, \alpha)) \leq V(X(t), t|X(t-1))$. Since for $\forall s \geq t$, $X(s) > X_S^*(\eta, z, \alpha)$ and $\lim\limits_{s\to+\infty} X(s) = X_T^* > X_S^*(\eta, z, \alpha)$. Thus there must be existing a $\pi \in (0,1)$: for $\forall s \geq t$ the citizens take $X(s) = \pi X_S^*(\eta, z, \alpha) + (1-\pi)X_T^* > X_S^*(\eta, z, \alpha)$ and $X(s)$ satisfies $V(X_S^*(\eta, z, \alpha)) \leq V(X(s)) = V(\pi X_S^*(\eta, z, \alpha) + (1-\pi)X_T^*)$. This is impossible since $X_S^*(\eta, z, \alpha)$ is the optimal level under a stable path we have proved.

Thus it is sufficient to prove for every $z > 0$ and $\alpha \in (0,1)$, there exists a $\eta(z, \alpha) > 0$ such that

$$X_S^*(\eta, z, \alpha) = \frac{(1-e^{-\eta\Delta})\gamma_1(z, \alpha)}{2(1-e^{-\eta\Delta})^2\gamma_2(z, \alpha) + \dfrac{2(1-e^{-\eta\Delta})\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}} < X_T^*$$

Since

$$X_T^* = \frac{\gamma_1(z, \alpha)(1-e^{-(\lambda+\eta)\Delta})}{\gamma_2(z, \alpha)\times(1-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta}) + \beta(\lambda, \eta, \Delta) + (\gamma_2(z, \alpha) + \dfrac{\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-e^{-\eta\Delta})}$$

It is equivalent to prove

$$\frac{(1-e^{-\eta\Delta})\gamma_1(z, \alpha)}{2(1-e^{-\eta\Delta})^2\gamma_2(z, \alpha) + \dfrac{2(1-e^{-\eta\Delta})\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}} < \frac{\gamma_1(z, \alpha)(1-e^{-(\lambda+\eta)\Delta})}{\gamma_2(z, \alpha)\times(1-e^{-\eta\Delta})(1-e^{-(\lambda+\eta)\Delta}) + \beta(\lambda, \eta, \Delta) + (\gamma_2(z, \alpha) + \dfrac{\beta(\lambda, \eta, \Delta)}{1-e^{-(\lambda+\eta)\Delta}}\mu)(1-e^{-\eta\Delta})}$$

$$\Leftrightarrow$$

$$\beta(\lambda, \eta, \Delta)\times\frac{e^{-\eta\Delta}(1-e^{-\lambda\Delta}\mu)}{(1-e^{-(\lambda+\eta)\Delta}\mu)} > \gamma_2(z, \alpha)\times(1-e^{-\eta\Delta})(2+e^{-(\lambda+\eta)\Delta})$$

Let $f(\eta|z, \alpha) = \beta(\lambda, \eta, \Delta)\times\dfrac{e^{-\eta\Delta}(1-e^{-\lambda\Delta}\mu)}{(1-e^{-(\lambda+\eta)\Delta}\mu)} - \gamma_2(z, \alpha)\times(1-e^{-\eta\Delta})(2+e^{-(\lambda+\eta)\Delta})$

$\lim\limits_{\eta\to 0} f(\eta|z, \alpha) = \dfrac{1-e^{-\lambda\Delta}}{\lambda}\beta > 0$. Therefore for every $z > 0$ and $\alpha \in (0,1)$, there exists a $\eta(z, \alpha) > 0$ such that $\forall \eta \in (0, \eta(z, \alpha)) \Rightarrow V(X_S^*(\eta, z, \alpha)) > V(X(t), t|X(t-1))$.

Corollary 1.

Proof:

Obviously, it is sufficient to prove for $\underline{V} = V(X_T^*)$ and a limited number of the external shocks happening in the first N period, the above statement is true.

According to proposition 3, for every $z > 0$ and $\alpha \in (0, 1)$, there exists a $\varepsilon > 0$ and $\eta(z, \alpha, \varepsilon) > 0$ and such that $\eta < \eta(z, \alpha, \varepsilon) \Rightarrow V(X_S^*(\eta, z, \alpha)) > (1 + \varepsilon)V(X_T^*)$

$$V(X_S^*(\eta, z, \alpha), N) = 0 + e^{-\lambda\Delta(N+1)}V(X_S^*(\eta, z, \alpha)) > V(X_T^*)$$

$$\Leftrightarrow$$

$$V(X_S^*(\eta, z, \alpha)) > e^{\lambda\Delta(N+1)}V(X_T^*)$$

Let $e^{\lambda\Delta(N+1)} < 1 + \varepsilon \Rightarrow \Delta < \dfrac{\ln(1+\varepsilon)}{\lambda(N+1)}$

Therefore, for every $z(t) \geq 0$, $0 < \underline{V} \leq V(X_T^*)$ and a limited number of external shocks $0 \leq N < +\infty$, there exists a $\eta(z, \alpha) > 0$ and $\Delta(\underline{V}, N) > 0$ such that $\forall \eta \in (0, \eta(z, \alpha))$ and $\forall \Delta \in (0, \Delta(\underline{V}, N)) \Rightarrow V(X_S^*(\eta, z, \alpha), N) > \underline{V}$.

Proposition 3.

Proof:

Since $\lim_{\alpha \to 1} R^*(\alpha, \eta_2) = 0 < R^*(\alpha_1, \eta_1)$ thus for $\forall \varepsilon > 0$, $\alpha_1 \in (0, 1)$ and $R^*(\alpha_1, \eta_1) \in (0, 1)$, [17] there exist a $\delta(\varepsilon, \eta_2, R^*(\alpha_1, \eta_1)) < 1 - \alpha_1$ such that $\forall \alpha \in (1 - \delta(\varepsilon, \eta_2, R^*(\alpha_1, \eta_1)), 1) \Longrightarrow R^*(\alpha, \eta_2) < R^*(\alpha_1, \eta_1)$.

Let $\alpha_2 = 1 - \delta(\varepsilon, \alpha_1, R^*(\alpha_1, \eta_1))$.

Corollary 2.

Proof:

From the first order condition

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[17] If $\varepsilon \geq 1$ thus the proposition is obviously true, so I do not need to consider this case.

$$\Gamma(\mu) = \gamma_2(z, \alpha)(2 - e^{-(\lambda+\eta)\Delta}) \times (\mu - e^{-\eta\Delta})(1 - e^{-(\lambda+\eta)\Delta}\mu) + \beta(\lambda, \eta, \Delta)(-e^{-(\lambda+\eta)\Delta}\mu^2 + 2\mu - e^{-\eta\Delta}) = 0$$

$$\frac{dz}{d\alpha} = -\frac{\partial\Gamma/\partial\alpha}{\partial\Gamma/\partial z} = -\frac{(2 - e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta} - \mu)(1 - e^{-(\lambda+\eta)\Delta}\mu) \times \dfrac{d\gamma_2(z, \alpha)}{d\alpha}}{(2 - e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta} - \mu)(1 - e^{-(\lambda+\eta)\Delta}\mu) \times \dfrac{d\gamma_2(z, \alpha)}{dz}} = \frac{z}{1-\alpha}$$

To keep R^* as a constant and satisfy the F.O.C, let

$$\frac{dz}{d\alpha} = -\frac{\partial R^*(\alpha, z)/\partial\alpha}{\partial R^*(\alpha, z)/\partial z} = -\frac{\dfrac{(e^{-\eta\Delta} - \mu)}{(1-\mu)} \times \dfrac{d\gamma_1(z, \alpha)}{d\alpha} + \dfrac{\gamma_1(z, \alpha)(e^{-\eta\Delta} - 1)}{(1-\mu)^2} \times \dfrac{d\mu}{d\alpha}}{\dfrac{(e^{-\eta\Delta} - 1)\gamma_1(z, \alpha)}{(1-\mu)^2} \times \dfrac{d\mu}{dz} + \dfrac{(e^{-\eta\Delta} - \mu)}{(1-\mu)} \times \dfrac{d\gamma_1(z, \alpha)}{dz}}$$

$$= -\frac{(1-\mu)(e^{-\eta\Delta} - \mu) \times \dfrac{d\gamma_1(z, \alpha)}{d\alpha} + (e^{-\eta\Delta} - 1)\gamma_1(z, \alpha) \times \dfrac{d\mu}{d\alpha}}{(1-\mu)(e^{-\eta\Delta} - \mu) \times \dfrac{d\gamma_1(z, \alpha)}{dz} + (e^{-\eta\Delta} - 1)\gamma_1(z, \alpha) \times \dfrac{d\mu}{dz}}$$

$$= \frac{z}{1-\alpha}$$

$$\Rightarrow \frac{dz}{d\alpha} = -\frac{d\mu/d\alpha}{d\mu/dz} = \frac{z}{1-\alpha}$$

Therefore, $\dfrac{dz}{d\alpha} = \dfrac{z}{1-\alpha}$ is the condition to keep the F.O.C and R^* unchanged. So

$$\frac{dz/z}{d\alpha/\alpha} = \frac{\alpha}{z} \times \frac{z}{1-\alpha} = \frac{\alpha}{1-\alpha}$$

Proposition 4 can be derived from Proposition 3. Proof is omitted here.

Lemma 1. Proof is similar to Proposition 2.

Proposition 5.

Proof:

(1) Since $\eta(t) = \eta_0 e^{\psi t}$, the proposition 2 cannot be hold any more. While $\eta_0 < \eta(z, \alpha) < +\infty$ satisfies the proposition 2, there must be existing a $t_1(\psi, \eta_0 | z, \alpha) \in (0, +\infty)$ which inspires the citizens move to an unrest path. [18]

(2) Now we just need to show that switch to the unrest path in the beginning of the game cannot be a Markov equilibrium. It is equivalent to show that there exists a $t_2(\psi, \eta_0 | z, \alpha) \in [1, t_1(\psi, \eta_0 | z, \alpha)]$ and the citizens would like to stay on the stable path until $t_2(\psi, \eta_0 | z, \alpha)$ period. Thus it is sufficient to demonstrate the citizens will maintain $X_S^*(\eta_0, z, \alpha)$ for at least the first two period before switch to the unrest path. Assume the value of an unrest path is V_U. Then the condition for the citizens to temporarily stay on the stable path is going to be:

$$V_U \leq X_S^*(\eta_0, z, \alpha)(1 - e^{-\eta_0 e^{\psi t}\Delta}) \times \{\gamma_1(z, \alpha) - \gamma_2(z, \alpha) \times X_S^*(\eta_0, z, \alpha)(1 - e^{-\eta\Delta}) - \frac{\beta(\lambda, \eta, \Delta)X_S^*(\eta_0, z, \alpha)}{1 - e^{-(\lambda + \eta_0 e^{\psi t})\Delta}} + e^{-\lambda\Delta}V_U$$

$$\Leftrightarrow$$

$$V_U \leq e^{-\lambda\Delta} \times \{X_S^*(\eta_0, z, \alpha)(1 - e^{-\eta_0 e^{\psi t}\Delta}) \times \{\gamma_1(z, \alpha) - \gamma_2(z, \alpha) \times X_S^*(\eta_0, z, \alpha)(1 - e^{-\eta\Delta}) - \frac{\beta(\lambda, \eta, \Delta)X_S^*(\eta_0, z, \alpha)}{1 - e^{-(\lambda + \eta_0 e^{\psi t})\Delta}}\}$$

By assumption, the above condition is satisfied when $t = 0$, so there must be existing a $\psi(\eta_0 | z, \alpha) > 0$ which makes the above condition qualified at $t = 1$.

In sum, there exists a $\psi(\eta_0 | z, \alpha) > 0$ and crucial time point $t(\psi, \eta_0 | z, \alpha) > 1$ such that

$$g(s, t, X) = \begin{cases} X_S^*(\eta_0, z, \alpha) & \text{if} \quad s \leq t(\psi, \eta_0 | z, \alpha) \\ X_U^* + \mu^{(s-t)}(X(t) - X_U^*) & \text{if} \quad s > t(\psi, \eta_0 | z, \alpha) \end{cases}$$

Proposition 6.

Proof:

Notice $\dfrac{dR^*}{dt} = \dfrac{dR^*}{dz(t)} \times \dfrac{dz(t)}{dt}$

$$R^* = \frac{(1 - e^{-\eta\Delta})X^*}{K} = \frac{\gamma_1(z, \alpha)(1 - e^{-\eta\Delta})(1 - e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta} - \mu)}{Ke^{-\eta\Delta}\beta(\lambda, \eta, \Delta)(1 - \mu)} \quad \Rightarrow$$

---

[18] Assume ψ and η_0 are small enough so that $t_1(\psi, \eta_0 | z, \alpha) \geq 2$.

$$\frac{dR^*}{dz} < 0 \iff \frac{dX^*}{dz} < 0 \iff \frac{d[\dfrac{\gamma_1(z,\alpha)(e^{-\eta\Delta} - \mu)}{(1-\mu)}]}{dz} < 0$$

$$\iff \frac{(e^{-\eta\Delta} - 1)\gamma_1(z,\alpha)}{(1-\mu)^2} \times \frac{d\mu}{dz} + \frac{(e^{-\eta\Delta} - \mu)}{(1-\mu)} \times \frac{d\gamma_1(z,\alpha)}{dz} < 0$$

$$\iff \frac{d\mu}{dz} > \frac{(1-\mu)(e^{-\eta\Delta} - \mu) \times [\dfrac{\partial\gamma_1(z,\alpha)}{\partial z} + \dfrac{\partial\gamma_1(z,\alpha)}{\partial\alpha} \times \dfrac{d\alpha}{dz}]}{(1-e^{-\eta\Delta})\gamma_1(z,\alpha)}$$

From the first order condition

$$\Gamma(\mu) = \gamma_2(z,\alpha)(2 - e^{-(\lambda+\eta)\Delta}) \times (\mu - e^{-\eta\Delta})(1 - e^{-(\lambda+\eta)\Delta}\mu) + \beta(\lambda,\eta,\Delta)(-e^{-(\lambda+\eta)\Delta}\mu^2 + 2\mu - e^{-\eta\Delta}) = 0$$

We have

$$\frac{d\mu}{dz} = -\frac{\partial\Gamma/\partial z}{\partial\Gamma/\partial\mu} = \frac{(2 - e^{-(\lambda+\eta)\Delta})(e^{-\eta\Delta} - \mu)(1 - e^{-(\lambda+\eta)\Delta}\mu) \times [\dfrac{\partial\gamma_2(z,\alpha)}{\partial z} + \dfrac{\partial\gamma_2(z,\alpha)}{\partial\alpha} \times \dfrac{d\alpha}{dz}]}{\gamma_2(2 - e^{-(\lambda+\eta)\Delta})[1 - 2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1 - e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)}$$

So $\dfrac{dR^*}{dz} < 0$ is equivalent to

$$\frac{(2 - e^{-(\lambda+\eta)\Delta})(1 - e^{-(\lambda+\eta)\Delta}\mu) \times [\dfrac{\partial\gamma_2(z,\alpha)}{\partial z} + \dfrac{\partial\gamma_2(z,\alpha)}{\partial\alpha} \times \dfrac{d\alpha}{dz}]}{\gamma_2(2 - e^{-(\lambda+\eta)\Delta})[1 - 2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1 - e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} > \frac{(1-\mu)[\dfrac{\partial\gamma_1(z,\alpha)}{\partial z} + \dfrac{\partial\gamma_1(z,\alpha)}{\partial\alpha} \times \dfrac{d\alpha}{dz}]}{(1 - e^{-\eta\Delta})\gamma_1(z,\alpha)}$$

$\iff$

$$\frac{(2 - e^{-(\lambda+\eta)\Delta})(1 - e^{-(\lambda+\eta)\Delta}\mu) \times [(1-\alpha)z\dfrac{\partial\gamma_2(z,\alpha)}{\partial z} + (1-\alpha)z\dfrac{\partial\gamma_2(z,\alpha)}{\partial\alpha} \times \dfrac{d\alpha}{dz}]}{\gamma_2(2 - e^{-(\lambda+\eta)\Delta})[1 - 2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1 - e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} > \frac{(1-\mu)[(1-\alpha)z\dfrac{\partial\gamma_1(z,\alpha)}{\partial z} + (1-\alpha)z\dfrac{\partial\gamma_1(z,\alpha)}{\partial\alpha} \times \dfrac{d\alpha}{dz}]}{(1 - e^{-\eta\Delta})\gamma_1(z,\alpha)}$$

$\iff$

$$\frac{(2 - e^{-(\lambda+\eta)\Delta})(1 - e^{-(\lambda+\eta)\Delta}\mu)\gamma_2(z,\alpha) \times [(1-\alpha) - z \times \dfrac{d\alpha}{dz}]}{\gamma_2(2 - e^{-(\lambda+\eta)\Delta})[1 - 2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1 - e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} > \frac{(1-\mu)[(1-\alpha) - z \times \dfrac{d\alpha}{dz}]}{(1 - e^{-\eta\Delta})}$$

According to Proposition 1,

$$\frac{(2 - e^{-(\lambda+\eta)\Delta})(1 - e^{-(\lambda+\eta)\Delta}\mu)\gamma_2(z,\alpha)}{\gamma_2(2 - e^{-(\lambda+\eta)\Delta})[1 - 2e^{-(\lambda+\eta)\Delta}\mu + e^{-(\lambda+2\eta)\Delta}] + 2(1 - e^{-(\lambda+\eta)\Delta}\mu)\beta(\lambda,\eta,\Delta)} < \frac{(1-\mu)}{(1 - e^{-\eta\Delta})}$$

Therefore, when $\dfrac{d\alpha(t)}{dz(t)} > \dfrac{1-\alpha(t)}{z(t)}$, $\dfrac{dR^*}{dt} < 0$; when $\dfrac{d\alpha(t)}{dz(t)} < \dfrac{1-\alpha(t)}{z(t)}$, $\dfrac{dR^*}{dt} > 0$

Since $\dfrac{d^2\alpha}{dz^2} > 0$, there must be existing one and only one $z(t) = z(\alpha) < +\infty$

satisfing $\dfrac{d\alpha(t)}{dz(t)}\Big|_{z(t)=z(\alpha)} = \dfrac{1-\alpha(t)}{z(t)}$ such that $\forall z(t) \in (0, z(\alpha)) \Rightarrow \dfrac{dR^*}{dt} > 0$ and

$\forall z(t) \in (z(\alpha), +\infty) \Rightarrow \dfrac{dR^*}{dt} < 0$.

Chapter 2

Central Autocratic System, Peasants' Revolts and the Collapse of Chinese Dynasties

Introduction:

In 221 B.C., Qin Shihuang, the first emperor in the Chinese history, unified China and created a completely new institution of government administration—Central Autocratic System (CAS) which is totally different from the Chinese feudalism during Xia (2000-1500 B.C.), Shang (1700-1027 B.C.) and Zhou (1027-221 B.C.) dynasties. Since then the feudalism had never been recovered and the CAS had lasted for over 2000 years in China (Qian, 1996)[19]. The CAS in China is a type of central-local-grassroots government administration system in which the emperor is at the core of administration and namely has the absolute authority; and the local officials are the agents of the central authority in governing local affairs. From 221B.C. to 1911—the end of Qing which is the last dynasty in the Chinese history, there were more than ten successive dynasties and the rise and fall of these dynasties is usually called Chinese dynastic cycle (Fairbank, 1971; Usher, 1989). While the new dynasties always inherited the previous political and economic institutions (Mao, 1952), and they wished to establish an eternal empire, most of dynasties, however, collapsed with peasants rebellions provoked by the corruption of the local bureaucracy (Fairbank, 1971). Also, the variance of the duration of these empires, ranging from 14 to 289 years, is very large as we can see in Table 1. According to Jian Bozan (1951), a famous Chinese historian, there are more than one thousand peasants' revolts in the Chinese history. Almost twenty of them involved with the number of participants from hundreds of thousands to more than one million. It is estimated that about twenty million people died during the Taiping Movement (1851-1864), the largest peasant revolt in the Chinese history. In the west Europe, only the German Peasants' War that took place in the early 16 century was comparable to those Chinese peasants' wars.

Chinese history has a record of resistance and revolt second to none (Perry and Selden, 2003) and China is often viewed as the principle case of a society that gave rise to peasant revolts (Moore, 1966; Eisenstadt, 1963; Kautsky, 1981). Eberhard (1965) concludes that peasant rebellions in China happened "almost every year," though "rarely had they any real success." Why were there so many large scale peasants' revolts that had a significant influence on the dynasty stability in the Chinese history? Why are there large variations in the duration of reign within the dynastic cycle?

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[19] Even though in Chinese textbooks these dynasties are still defined as feudal society, more and more scholars agree that the Chinese feudalism was ended since Qin unified China in 221 B.C. (See Quigley 1923, Qian 1996&2001, Huang 1991, and Wang 1997.)

Table 1: The Establishment and Collapse of Chinese Dynasties (221B.C.—1911A.D.)

Dynasty	Starting Year	Ending Year	Ruling Years	The Establishment	The Collapse
Qin	-221	-207	14	Inter-State War	Peasant Revolt
Western_Han	-206	24	230	Peasant Revolt	Peasant Revolt
Eastern_Han	25	220	195	Peasant Revolt	Peasant Revolt
Western_Jin	265	316	51	Inter-State War	Inter-State War
Eastern_Jin	317	420	103	Inter-State War	Official Rebel
Sui	581	617	36	Inter-State War	Peasant Revolt
Tang	618	907	289	Peasant Revolt	Peasant Revolt
North_Song	960	1127	167	Inter-State War	Inter-State War
South_Song	1127	1279	152	Inter-State War	Inter-State War
Yuan	1279	1368	89	Inter-State War	Peasant Revolt
Ming	1368	1644	276	Peasant Revolt	Peasant Revolt
Qing	1644	1911	267	Peasant Revolt	Xinhai Revolution

Note: (1) Xin Dynasty (9-24 A.D.) is included in Western Han Dynasty.

(2) Three Kingdoms, Southern and Northern, Five Dynasties and Ten Kingdoms are not included in this table since China was not unified during these periods.

(3) Establishment of Dynasties refers to the major war before the dynasty was established.

(4) Collapse of Dynasties refers to how the dynasty was collapsed.

In this paper, I develop a static model by integrating Crawford and Sobel's cheap talk model (1982) and Hoff and Stiglitz's model of anarchy of demand for the rule of law (2004). There are two important assumptions in the model. First, regime security under CAS was influenced by the portion of peasant proprietors. In the imperial China, agricultural sector dominates the country's economy and only a tiny percentage of population is employed in industry and commerce sectors. Second, the initial land distribution function was formed by the type of the preceding war before the dynasty was built. Specifically speaking, if the new dynasty was built after a large scale peasants' rebellion, then the land distribution function is supposed to be more even by assumption. Otherwise, if the new dynasty was built on an interstate war, then a more unequal distribution is expected.

The model generates several important findings. First, the dynastic stability is determined by two equilibria— a Perfect Bayesian Equilibrium (PBE) in a cheap talk game played between the center and the local officials, and an equilibrium of the portion of peasant proprietors which is shaped by the Social Stability Curve (SSC) and peasant Status Switch Line (SSL). The SSC is defined as the relationship between the portion of peasants' proprietors and the initial land distribution function. Likewise, the peasant SSL is the condition in which peasants feel indifferent between remaining and leaving their

lands. The PBE outcome in the cheap talk game reflects that the peasants' economic burden is the consequence of the center versus local bargaining. The portion of peasant proprietors is thus the peasants' response on their expected benefits of keeping the land and the initial land distribution in the whole society. The dynasty becomes less stable as the cheap talk game yields a higher tax burden on the peasants. Other things being equal, the dynasty with a more even land distribution function is expected to be more stable.

Second, there is only pooling PBE and no partial pooling or separating equilibrium is identified in the cheap talk model. This implies that in a CAS dynasty, the rent-seeking space is always available to the local officials as long as they care less about peasants' well-being than the emperor. The emperor and local officials cannot coincide in economic interests for at least two reasons. On one hand, unlike the ruler's position, local agents' position is non-tenured and usually cannot be inherited by their off springs. On the other hand, local agents perceive a lower probability of peasants rebellions compared with the emperor since local agents only focus on local affairs. In contrast, the emperor perceives the regime stability as a joint probability of peasants' rebellions across the country.

Third, the portion of peasants' proprietors has a tendency of decreasing over time in a CAS dynasty. In the cheap talk model, the ruler has a dilemma between increasing and decreasing tax rates to protect peasants' interest and thus dynasty security. If the center adopts a low tax rate, it will have insufficient resources to constrain local agents' corruption. As a result, the rampant corruption increases the number of peasants losing their lands. If the center adopts a high tax rate, a decrease in the portion of peasants' proprietors becomes the direct consequence of the central policy and external shock. In sum, the ruler in CAS dynasty has limited ability to protect peasants' interest. That's why the portion of peasants' proprietors has a tendency of decreasing over time in a CAS dynasty. Consequently, peasants' rebellion becomes inevitable as the portion of peasants' proprietors keeps decreasing.

Fourth, the variance of the duration of reign can be explained by the initial land distribution function for each dynasty. As the new dynasty inherits political and economic institutions from previous dynasty, the equilibrium outcome of the cheap talk game between the center and local agents remain stable. So, the regime stability is subject to the intersection of the SSC and peasant SSL. The SSL is peasants' response to governments' tax policy so it is stable as well. Thus the duration of reign varies by the initial land distribution.

In sum, the uprising peasant rebellions are the consequence of weak centralized institution in a traditional society. The dynasty longevity is predetermined by the initial land distribution function. As the emperor in a CAS dynasty cannot constrain its local agents' behavior efficiently, a decrease in the portion of peasants' proprietors and therefore the grassroots rebellions are inevitable to induce the collapse of a typical Chinese dynasty. Certainly, the collapse of an old dynasty does not necessarily mean the birth of a new one—the country might be separated. Before the new dynasty is built in Chinese history, there is always a proceeding war, either a peasants' war or an interstate war or both. It is interesting that the new dynasty built on a peasants war usually can live much longer than the one built on an interstate war. Thus it is more likely there is a

peasants' rebellion cycle rather than a dynastic cycle in the Chinese history—this can be seen more clearly in the empirical section later.

This paper challenges the dominant "Population Theory" on the Chinese dynastic cycle and provides an alternative explanation on this topic. Figure 1 describes a typical theoretical framework of the demographic and dynastic cycles. According to this theory, population grows rapidly at the beginning of a new regime due to its initial economic prosperity, peace and order. Since production technology keeps fixed and the amount of resources such as arable land remains limited, the average peasant's income decreases as population grows in a pre-modern society. Along with natural checks such as famine and epidemics, the population size shrinks, and the incidence of peasant revolts increases which results in the collapse of the dynasty. Elvin (1973) provides a solid historical background for the population theory, and argues that China's situation in the context of a civilization may be described as a high-level equilibrium trap. Using a game model, Usher (1989) provides a novel explanation of why dynasties disintegrate over time. In a society with three social classes – farmers, bandits and rulers, the population growth leads to a gradual fall in per-capita income, until eventually the surplus over subsistence living is insufficient to provide for the ruling class. Consequently, an alternation between anarchy and despotism emerges and a dynastic cycle is formed. Chu and Lee (1994) proposes an occupation- specific population structure, and states that internal changes in population compositions form the so-called dynastic cycles. Nefedov's research (2004) is also devoted to the population theory by taking into account for variables such as population, the size of sowing areas, the number of peasants and handicraftsmen.

While the population theory lays out a solid framework to study the Chinese dynastic cycle, there are still some concerns regarding its empirical evidence and theoretical explanation. From the empirical perspective, the endogeneity issue has not been given enough consideration. Although it is widely recognized that the population cycle is related to the dynastic cycle, it is less clear the direction of this relationship. Does the population cycle cause the dynastic cycle or vice versa? Also, the argument that overpopulation would result in catastrophes is hardly valid since China actually began its population explosion as late as the eighteenth century during the Qing Dynasty (Li, 1982). As a matter of fact, the Qing is the last CAS dynasty in the pre-modern Chinese history, and all the dynastic changes occurred prior to the Qing dynasty. What's more, the population theory needs further investigation how the per capita wealth evolved in the pre-modern Chinese history. There is no empirical data in this regard thus far.

From the theoretical perspective, the current population theory can also be improved in these aspects. First, the population theory failed to explain why imperial central government never implemented the birth control policy. If overpopulation has a negative impact on the regime stability, why did the center never control the birth rate throughout the whole dynasty history? Even in a period without advanced birth control techniques, the fertility rate can be significantly reduced if the official marriage age cutoff was lifted. The peasant revolt is the dominant reason for the collapse of dynasties. If overpopulation slows down the income growth and causes internal rebellion, the center can always solve the crisis by initializing an interstate war. Second, the population theory has limited power in explaining the large variance among the duration of the reign of the dynasties.

Figure 1: The Chinese Dynastic Cycle
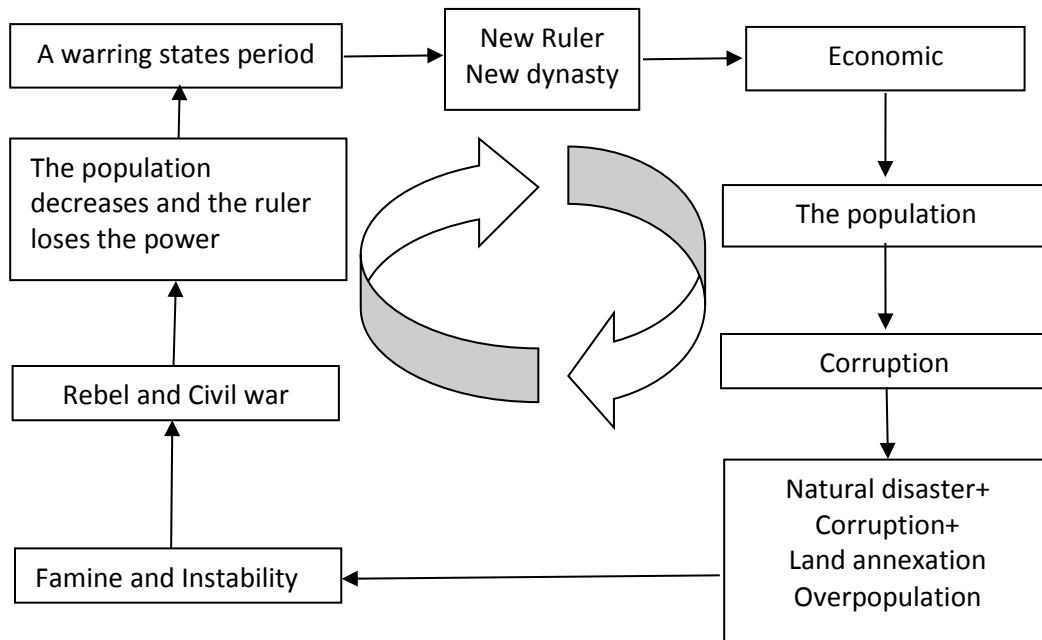
The Central Autocratic System in the Chinese History

The Central Autocratic System (CAS) was first created in 221 B.C by Qin Shihuang, the first emperor in the Chinese history. It is a type of government administration system in which the emperor is the core of authority. In this system, "The ruler's government was structured as a three-faced pyramid comprising a civil administration, a military establishment, and a censorial system; and each of these was a hierarchy of agencies or units extending from the central government down to regional and local levels" (Hucher, 1973. In "An introduction to Chinese Civilization", ed. by Meskill etc.). The CAS was favored by the center in order to reinforce the emperor's power. The traditional feudalism from the Zhou Dynasty was abolished gradually because the emperor considered the kings from across the country destabilized his regime. The centralization of emperor authority was completely confirmed after Seven-Kings rebel in 154 B.C. Despite many reforms of CAS over 2000 years, the political and economic institutions remained stable.

Within the CAS framework, the relationship between the emperor and local officials was complex. The Chinese emperor was understood to be the "Son of Heaven" in charge of everything- "the whole world is the land of the emperor, and all the troops are his officials (普天之下，莫非王土；率土之滨，莫非王臣)"; the local officials were local agents of the emperor. There were constant tensions between the emperor and local officials due to their conflicting interests. On the one hand, the emperor had to collaborate with officials to govern the country. Being born and raised in palace, the emperor had little or no direct knowledge of actual conditions of the empire while his

officials held the knowledge necessary to legitimate his power and apply it in the actual administration of government. For instance, the emperor was obligated to attend the regular ritual duties when floods, famines, epidemics, and the like broke out, and counted on expert guidance of officials to fulfill his duty. In this way, emperors and officials worked together and secured power and prestige for themselves and their families. On the other hand, the emperor's authority was frequently weakened by corruption and bureaucratic inaction. Although strong-willed emperor could win the contest after a difficult fight against the bureaucracy, it was hard to shake up the bureaucracy. According to this framework, the central government was incapable of redistributing land economically and curbing corruption politically. Along with the lower level of agricultural productivity, the distorted land distribution led to an increasingly worsened income inequality and a large number of landless peasants. The demand for land reform triggered peasant rebellions, which turned out to be an effective and expensive method to redistribute land (Li, 2003).

The issues of peasants and land annexation were crucial under the CAS regime. In the pre-industrial China, peasants were comprised of the overwhelming majority of the population. Agriculture dominated the country's economy and only a tiny percentage of population was employed in industry and commerce. Lack of any alternative to cultivation rendered peasants into extreme poverty once their land was taken away due to land annexation. Since the economy heavily relied on peasants' cultivation, new emperors and bureaucracy often initiated policies to reduce peasants' tax burdens and redistribute land to former landless peasants in order to stimulate economy and maintain political stability. However, those initiatives were hardly successful. A strong piece of evidence which shows the failure of the CAS is so-called "Huang Zongxi's Law" (Qin, 2002). The Huang's Law basically states that many emperors in the history realized the negative impacts of land annexation and tax burden on the peasants. So they made great effort to reduce the grassroots tax. Ironically, every time peasants economic burden released for only a short while and then jumped to a much higher level even than that before the reform. From the western Han to the Qing, "King-Land Regulation," "Even-Land Regulation," "One-Lash Regulation," "Poll-Land Regulation," all these significant economic reforms aimed to reduce peasants' tax burden and prevent the land annexation. Unfortunately, all the efforts failed to maintain the regime stability for a long time.

A Static Model of the Regime Stability in the Chinese Dynasties

The following model is based on Crowford and Sobel's cheap talk model (1982) and Hoff and Stiglitz's model of anarchy of demand for the rule of law (2004). There are three players in the model: peasant proprietors, central government (Emperor) and local officials.

Assumption 1. Dynasty security is influenced by the portion of peasant proprietors. Specifically speaking, the higher the portion of peasant proprietors, the more stable the CAS dynasty.

Assumption 2. The initial land distribution function is formed by the type of the preceding war before the dynasty was built. Specifically speaking, if the new dynasty was built after a large scale peasants' rebellion, then the land distribution function is supposed to be more even by assumption. Otherwise, if the new dynasty was built on an interstate war, then a more unequal distribution is in expectation.

Peasants

Suppose a peasant will not sell his land unless his economic payoff is less than a crucial threshold m. All the peasants are also assumed to have some land initially and the land size, s follows a distribution with a probability density function $f(s)$ on $[\underline{s}, \overline{s}]$ and a cumulative distribution function $F(s)$. When peasants need to pay the tax to governments, when there is local corruption or a natural disaster, etc., some peasants may have to sell or leave their land and become tenants or bandits. Suppose in a given time x is the portion of peasant proprietors so $1-x$ is the portion of tenants and bandits.

The political stability is highly influenced by x and some exogenous variables. Continue assuming $\omega(x)$ is the probability of regime security with $\omega(0)=0$ and $\omega(1)=1$ and $1-\omega(x)$ the probability of a revolt. Since peasants are the stabilizer of a dynasty we have $\omega'(x)>0$ which implies the more the peasant proprietors, the more stable the regime. Also I assume $\omega''(x)<0$.

Let t_C be the land tax rate enforced by the central government, t_L be the local land tax rate that is not authorized by the Emperor[20]. The agricultural output is g per land unit. Obviously, a peasant's payoff is going to be $gs-t_C gs-t_L gs$ in a peaceful environment. Once there is a war happening, all the peasants are expected to have some additional tax burden t_w. Thus a peasant's expectation can be described as follow:

$$R_p = \omega(x)\times(gs-t_C gs-t_L gs)+[1-\omega(x)]\times(gs-t_C gs-t_L gs-t_w gs)$$
$$=[1-t_C-t_L-(1-\omega(x))t_w]gs$$

By assumption the peasant will sell or leave his land if and only if $R_p=[1-t_C-t_L-(1-\omega(x))t_w]gs<m$.

Define $\Delta(s,x\,|\,t_C,t_L)=[1-t_C-t_L-(1-\omega(x))t_w]gs-m=0$. Then given a tax policy profile (t_C,t_L), $\Delta(s,x\,|\,t_C,t_L)=0$ is the peasants' status switch line (SSL) between status quo (peasant proprietor) and being a tenant or else. Suppose for any practical tax policies t_C and t_L which satisfy $1-t_C-t_L-t_w>0$, we have $\Delta(\overline{s},0\,|\,t_C,t_L)>0$. This simply implies the richest people are always able to afford the war tax.

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[20] There is no poll tax in the model even though it might be very high in some dynasties like Han, and Ming. I assume the land tax and the poll tax can be interchangeable perfectly in this paper.

The peasants' status switch line just demonstrates each individual's preference. We still don't know social stability equilibrium even with the government tax policy fixed. Suppose given a tax policy (t_C, t_L), peasant i with land size s_i just has $\Delta(s_i, x_i \mid t_C, t_L) = 0$ and the social stability is indicated by $\omega(x_i)$. Then we are supposed to have $\Delta(s, x_i \mid t_C, t_L) < 0$ for any $\underline{s} \le s < s_i$ which implies that peasants with land size $s < s_i$ have no choice but leave their land and those with land size $s \ge s_i$ are expected to keep status quo as $\Delta(s, x_i \mid t_C, t_L) \ge 0$. In other words, whether peasant i feels indifference not only depends on the status switch line, but is conditional on the land distribution in the whole society. If and only if $x_i = 1 - F(s_i)$, there is a status equilibrium for the peasants: x_i potion of people will keep their land with distribution on $[s_i, \bar{s}]$ and those $(1 - x_i)$ potion of peasants with land size $s < s_i$ will have to lose their land. To generalize this, I define:

Peasants' Equilibrium: Given a tax policy profile (t_C, t_L), a Peasants' Equilibrium is the maximum value of x such that

$$\begin{cases} x = 1 - F(s(x)) \\ \Delta(s, x \mid t_C, t_L) \ge 0 \end{cases}$$

The function of $x = 1 - F(s)$ highlights the relationship between social stability and peasants' land reservation. So $x = 1 - F(s)$ is called the Social Stability Curve (SSC). On the graph, a Peasants' Equilibrium generally is the intersection of social stability curve $x = 1 - F(s(x))$ and the Status Switch Line (SSL) $\Delta(s, x \mid t_C, t_L) = 0$ (and $x^* = 1$ if $\Delta(\underline{s}, 1 \mid t_C, t_L) \ge 0$). As $f(s)$ and therefore the SSC is predetermined, the SSL shaped by the central policy and local agents behavior played a key role in forming the equilibrium outcome of x. In sum, the regime stability of the Chinese dynasties is highly influenced by the initial land distribution and center-local policies. As we can see on Figure 2, if the tax policy profile (t_C, t_L) satisfies $\Delta(\underline{s}, 1 \mid t_C, t_L) \ge 0$, then there is a stable Peasants' Equilibrium $x^* = 1$. Otherwise there is an instable Peasants' Equilibrium $x^* < 1$.

Usually the rich peasants have more resources to afford a war and thus there is a negative correlation between s and x on the SSL curve. The similar logic can also be applied to the SSC. In addition, since the poor people are majority in any society, usually

we have $f'(s) < 0$. So social stability curve $x = 1 - F(s(x))$ and the SSL

$\Delta(s, x \mid t_C, t_L) = 0$, are also convex functions. i.e., $\dfrac{ds}{dx} < 0$ and $\dfrac{d^2 s}{dx^2} > 0$.

Lemma 1. The portion of peasant proprietors is convex function of the land size. That is
$\dfrac{dx}{ds} < 0$ and $\dfrac{d^2 x}{ds^2} > 0$.

Figure 2. The Social Stability Curve and Status Switch Line
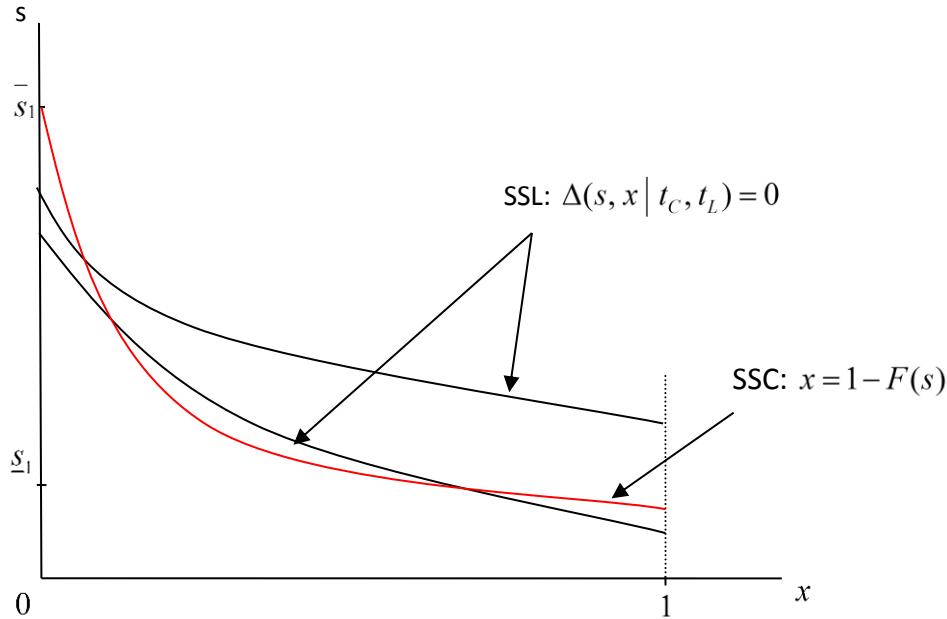
Graphically, the peasants' equilibrium is the intersection of the Social Stability Curve (SSC) and Status Switch Line (SSL). Since SSC is predetermined by the function of $x = 1 - F(s(x))$, the equilibrium outcome x^* is highly influenced by the central and local tax policies and it is easy to see that x^* is negatively correlated with the total tax burden $t_C + t_L$.

Proposition 1. For any practical tax policies t_C and t_L (i.e., $1 - t_C - t_L - t_w > 0$), there always exists a Peasants' Equilibrium.

Lemma 2. The equilibrium outcome of peasants x^* is negatively correlated with the total tax burden $t_C + t_L$.

The SSC is the social condition of dynastic stability. According to assumption 2, it is exogenous and determined by the preceding war. Thus, the portion of peasant proprietors and the dynastic security is decided by tax burden. Obviously, on the SSL, the land size s is positively correlated with $t_C + t_L$. According to Lemma 1 $\dfrac{dx}{ds} < 0$, this simply yields the negative relationship between x^* and $t_C + t_L$. Therefore, other conditions being equal, the central government's ability to constrain the level of tax burden plays a decisive role in keeping dynastic stability.

Emperor and its Local Agent

Unlike landlords in a feudalist society, the local officials in a central autocratic system do not have the property ownership on various regional resources. They are just the agents of the emperor principal to administrate the local affairs. Hence two critical issues arise within a centralized system for the central government. First, the local officials may not care about the peasants interests as much as the emperor does. Second, it is very difficult for the center to monitor its local agents' behavior efficiently especially in such a large traditional country.

As we have analyzed before, the peasants' equilibrium and therefore the regime stability is highly influenced by the initial land distribution (the Social Stability Curve) and the center-local tax policies. In a centralized system, the tax burden on the peasants normally depends on to what extend the center ruler will be able to prevents the local corruption. So there is a real dilemma to the emperor—to maintain the regime stability, the total tax rate is supposed to be fixed at a low level. To decrease the corruption level and keep the regime stability, however, more resources is needed and the central tax rate is supposed to be raised.

In the CAS society, local agents actually become the final decision maker of tax policy. After observing the central policy, local officials' decision is supposed to be the best response of the center's strategy. As the center and local agents can not coincide their policy interest, the local agents' final decision of tax policy is determined by the center's information transmission strategy. In the following analysis, I develop Crowford and Sobel's cheap talk model (1982).

Let $T = t_C + t_L$ be the total tax rate. Suppose the central government's reservation tax rate is t_R which is naturally selected and the local official only know $t_R \sim U(\underline{t_C}, \overline{t_C})$. While the officials are the emperor's local agents, it does not mean they do not care about the peasants' interests at all. Assume they hold the belief that the peasants' economic threshold is m_L and the corresponding ideal tax rate is t_L^*. Here the ideal tax rate implies

t_L^* satisfying $\Delta(\underline{s},1\,|\,t_L^* = t_C + t_L, t_C \leq t_L^*) = (1-t_L^*)g\underline{s} - m_L = 0$ and the ruler believes

$t_L^* \sim U(\underline{t_L}, \overline{t_L})$. Suppose $\underline{t_C} < \underline{t_L} < \overline{t_C} < \overline{t_L}$.

Under a centralized system, the monitoring efficiency can be seen as a constant. Therefore t_R, the central governments reservation value, $U(\underline{t_C}, \overline{t_C})$, and $U(\underline{t_L}, \overline{t_L})$, the asymmetric information between the center and local governments play significant roles in determining the tax outcome.

In short, nature moves first and chooses $t_R \in (\underline{t_C}, \overline{t_C})$. The ruler selects the level of t_C with a message $m(t_C)$ about the position of t_R and sends them to its local agents. The local officials observe t_C and $m(t_C)$ then pick up t_L according to the expectation of the center's cost on monitoring local corruption. The total tax burden on the peasants finally is going to be $T = t_C + t_L$.

Notice t_R is the center's reservation rate, we have $t_C \geq t_R$ at any time. Given this condition, the center always desires to minimize $T = t_C + t_L$. Let's define the center's utility function $U_C = -(T - t_C - t_L)^2$, $t_C \geq t_R$. By assumption, the local agents may not care about the peasants' interests as much as the emperor does. Define the local officials' utility function $U_L = -(t_C + t_L + \theta - t_L^*)^2$, where $\theta = (1 - e^{\lambda(t_R - t_C)})(t_L^* - t_C)$. λ is a positive number indicating the efficiency of the center's ability in constraining the local's wrong behavior under the central autocratic system. $\theta = (1 - e^{\lambda(t_R - t_C)})(t_L^* - t_C)$ demonstrates the optimal level of tax revenue that the local official should give up under λ and asymmetric information constrains. Obviously, as $\lambda \to 0$ which means the central autocratic system has complete inefficiency, the local officials will simply take $t_L = t_L^* - t_C$ as long as $t_C < t_L^*$. $\lambda \to +\infty$ implies the central autocratic system has complete efficiency and a very small monitoring investment can make $t_L = 0$.

From the first order condition, we have

$$\frac{\partial U_C}{\partial t_C} = 2(T - t_C - t_L) = 0 \implies T = t_C + t_L$$

$$\frac{\partial U_L}{\partial t_L} = -2(t_C + t_L + \theta - t_L^*) = 0 \implies t_L = t_L^* - t_C - \theta$$

Therefore $E(t_L) = \begin{cases} 0 & \text{if } t_L^* \leq t_C \\ e^{\lambda[E(t_R|m(t_C)) - t_C]} \times (t_L^* - t_C) & \text{if } t_C < t_L^* \end{cases}$

And the total tax expectation is going to be

$$E(T) = E(t_C) + E(t_L) = \begin{cases} t_C & \text{if } t_L^* \leq t_C \\ t_C + e^{\lambda[E(t_R|m(t_C)) - t_C]} \times [E(t_L^*) - t_C)] & \text{if } t_C < t_L^* \end{cases}$$

In this Perfect Bayesian Equilibrium game, a key issue is how the central government would like to reveal the information about t_R to its local agents. Just like a normal sender-receiver game, the ruler will never reveal the exact position of t_R to local officials so there is no fully separating equilibrium in this game. Assume there is one in which the ruler will send message $m(t_C)$ discovering t_R. Then given local officials' belief and strategy, the ruler can always be better-off by sending $m'(t_C)$ and revealing a value that is smaller than t_R to local officials. So there is no fully separating equlibirum in this game and all Perfect Bayesian Equilibria are partition equilibria. In fact, a fully pooling equilibrium is the unique PBE in this game as we can see later. First let's consider the ruler only plays a fully pooling game in which any information about t_R will not be revealed except the common knowledge of $t_C \geq t_R$.

A Fully Pooling Strategy

Under a fully pooling strategy, the local agents can only update his posterior beliefs on t_R according to the position of t_C. Obviously, a rational choice of t_C cannot be smaller than t_R or larger than $\overline{t_L}$. So once t_C is observed, the local agents' best reply will be

$$t_L = \begin{cases} e^{\frac{\lambda(t_{\underline{C}} + \overline{t_C} - 2t_C)}{2}} \times (t_L^* - t_C) & \text{if } \overline{t_C} < t_C < t_L^* \\ e^{\frac{\lambda(t_{\underline{C}} - t_C)}{2}} \times (t_L^* - t_C) & \text{if } t_R \leq t_C \leq \overline{t_C} \text{ and } t_C < t_L^* \\ 0 & \text{if } t_L^* \leq t_C \end{cases}$$

And the ruler's expectation on the total tax rate is going to be

$$E(T) = E(t_C) + E(t_L) = \begin{cases} t_C + e^{\frac{\lambda(t_{\underline{C}} - t_C)}{2}} \times (\dfrac{t_L + \overline{t_L}}{2} - t_C) & \text{if } t_R \le t_C \le \underline{t_L} \\[2ex] t_C + \dfrac{\overline{t_L} - t_C}{t_L - \underline{t_L}} \times e^{\frac{\lambda(t_{\underline{C}} - t_C)}{2}} \times (\dfrac{\overline{t_L} - t_C}{2}) & \text{if } \underline{t_L} < t_C \le \overline{t_C} \\[2ex] t_C + \dfrac{\overline{t_L} - t_C}{t_L - \underline{t_L}} \times e^{\frac{\lambda(\overline{t_C} + t_{\underline{C}} - 2t_C)}{2}} \times (\dfrac{\overline{t_L} - t_C}{2}) & \text{if } \overline{t_C} < t_C \le \overline{t_L} \end{cases}$$

In the game, the local agent is the later mover and his strategy is always his best response to the ruler's choice of t_C. To keep the regime stability, the ruler always prefer the lowest tax rate as long as $t_C \ge t_R$. Therefore, the ruler's strategy which minimizes $E(T)$ will basically lead to a pooling equilibrium.

$$\frac{dE(T)}{dt_C} = \begin{cases} 1 - [1 + \dfrac{\lambda(t_L + \overline{t_L} - 2t_C)}{4}] \times e^{\frac{\lambda(t_{\underline{C}} - t_C)}{2}} & \text{if } t_R \le t_C \le \underline{t_L} \\[2ex] 1 - \dfrac{4(\overline{t_L} - t_C) + \lambda(\overline{t_L} - t_C)^2}{4(t_L - \underline{t_L})} \times e^{\frac{\lambda(t_{\underline{C}} - t_C)}{2}} & \text{if } \underline{t_L} < t_C \le \overline{t_C} \\[2ex] 1 - \dfrac{2(\overline{t_L} - t_C) + \lambda(\overline{t_L} - t_C)^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda(\overline{t_C} + t_{\underline{C}} - 2t_C)}{2}} & \text{if } \overline{t_C} < t_C \le \overline{t_L} \end{cases}$$

And $\dfrac{d^2E(T)}{dt_C^2} > 0$ for any $t_C \in [t_R, \overline{t_L}]$. $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C = t_{\underline{C}}^+} = -\dfrac{\lambda(t_L + \overline{t_L} - 2t_C)}{4} < 0$,

$\left.\dfrac{dE(T)}{dt_C}\right|_{t_C = t_{\underline{L}}^-} = \left.\dfrac{dE(T)}{dt_C}\right|_{t_C = t_{\underline{L}}^+}$, $\left.\dfrac{dE(t)}{dt_C}\right|_{t_C = \overline{t_C}^-} > \left.\dfrac{dE(t)}{dt_C}\right|_{t_C = \overline{t_C}^+}$, $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C = \overline{t_L}^-} = 1 > 0$.

There is one discontinuous point of $\dfrac{dE(T)}{dt_C}$ at $t_C = \overline{t_C}$ on the whole interval $[t_{\underline{C}}, \overline{t_L}]$,

but it is easy to see that $t_C = \overline{t_C}$ generally cannot be the ruler's equilibrium strategy unless $t_R = \overline{t_C}$ and $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C = \overline{t_C}^+} \ge 0$. Obviously, if $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C = \overline{t_C}^-} > \left.\dfrac{dE(T)}{dt_C}\right|_{t_C = \overline{t_C}^+} \ge 0$, the ruler's pooling equilibrium strategy is to place t_C somewhere in $(t_{\underline{C}}, \overline{t_C})$. If $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C = \overline{t_C}^+} < \left.\dfrac{dE(T)}{dt_C}\right|_{t_C = \overline{t_C}^-} \le 0$, then there is a unique PBE in which t_C will be placed in $(\overline{t_C}, \overline{t_L})$. However, these equilibria should be found under some loose conditions. In other

words, if we have $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C=\overline{t_C}^-}>0$ and $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C=\overline{t_C}^+}<0$, the ruler's high level strategy

$t_C>\overline{t_C}$ (or low level strategy $t_C<\overline{t_C}$) may still lead to a unique equilibrium under some circumstances and it is possible to find two Perfect Bayesian Equilibria in which the ruler has no difference between a high t_C and a low t_C.

To simplify the calculation in searching PBEs, first let's define

$$
\Gamma(\lambda,t_C)=e^{\frac{\lambda(t_C-t_{\underline{C}})}{2}}\times\frac{dE(T)}{dt_C}=\begin{cases} e^{\frac{\lambda(t_C-t_{\underline{C}})}{2}}-\dfrac{\lambda(t_{\underline{L}}+\overline{t_L}-2t_C)}{4}-1 & \text{if } t_R\le t_C\le t_{\underline{L}} \\[4mm] e^{\frac{\lambda(t_C-t_{\underline{C}})}{2}}-\dfrac{4(\overline{t_L}-t_C)+\lambda(\overline{t_L}-t_C)^2}{4(\overline{t_L}-t_{\underline{L}})} & \text{if } t_{\underline{L}}<t_C\le\overline{t_C} \\[4mm] e^{\frac{\lambda(t_C-t_{\underline{C}})}{2}}-\dfrac{2(\overline{t_L}-t_C)+\lambda(\overline{t_L}-t_C)^2}{2(\overline{t_L}-t_{\underline{L}})}\times e^{\frac{\lambda(\overline{t_C}-t_C)}{2}} & \text{if } \overline{t_C}<t_C\le\overline{t_L} \end{cases}
$$

Hence $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C=\overline{t_C}^+}<0$ if and only if

$$
\Gamma(\lambda,\overline{t_C}^+)=e^{\frac{\lambda(\overline{t_C}-t_{\underline{C}})}{2}}-\frac{2(\overline{t_L}-\overline{t_C})+\lambda(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-t_{\underline{L}})}<0.
$$

Define $\lambda_a=\min\Gamma^{-1}(0\,|\,t_C=\overline{t_C}^+)$, $\lambda_b=\max\Gamma^{-1}(0\,|\,t_C=\overline{t_C}^+)$, where $\min\Gamma^{-1}(0\,|\,t_C=\overline{t_C}^+)$ and $\max\Gamma^{-1}(0\,|\,t_C=\overline{t_C}^+)$ are two solutions of $\Gamma(\lambda,\overline{t_C}^+)=0$ (if there are) and $\min\Gamma^{-1}(0\,|\,t_C=\overline{t_C}^+)<\max\Gamma^{-1}(0\,|\,t_C=\overline{t_C}^+)$. $\lambda_c=\min\Gamma^{-1}(0\,|\,t_C=\overline{t_C})$, $\lambda_d=\max\Gamma^{-1}(0\,|\,t_C=\overline{t_C})$, where $\min\Gamma^{-1}(0\,|\,t_C=\overline{t_C})$ and $\max\Gamma^{-1}(0\,|\,t_C=\overline{t_C})$ are two solutions of $\Gamma(\lambda,\overline{t_C})=0$ (if there are) and $\min\Gamma^{-1}(0\,|\,t_C=\overline{t_C})<\max\Gamma^{-1}(0\,|\,t_C=\overline{t_C})$.

Proposition 2a.

If $\ln\dfrac{(\overline{t_L}-\overline{t_C})^2}{(\overline{t_L}-t_{\underline{L}})(\overline{t_C}-t_{\underline{C}})}>\dfrac{\overline{t_L}+\overline{t_C}-2\overline{t_C}}{\overline{t_L}-\overline{t_C}}>0$ and $\lambda\in(\lambda_a,\lambda_b)$, then $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C=\overline{t_C}^+}<0$.

As the center and local agents diverge in their ideal policy interests, there is only one PBE equilibrium in which $t_C=\overline{t_C}$.

Define $\lambda_c = \min \Gamma^{-1}(0 \,|\, t_C = \overline{t_C})$, $\lambda_d = \max \Gamma^{-1}(0 \,|\, t_C = \overline{t_C})$, where $\min \Gamma^{-1}(0 \,|\, t_C = \overline{t_C})$ and $\max \Gamma^{-1}(0 \,|\, t_C = \overline{t_C})$ are two solutions of $\Gamma(\lambda, \overline{t_C}) = 0$ (if there are) and $\min \Gamma^{-1}(0 \,|\, t_C = \overline{t_C}) < \max \Gamma^{-1}(0 \,|\, t_C = \overline{t_C})$.

Proposition 2b.

If $\ln \dfrac{(\overline{t_L} - \overline{t_C})^2}{2(\overline{t_L} - \underline{t_L})(\overline{t_C} - \underline{t_C})} \geq \dfrac{\overline{t_L} + 2\underline{t_C} - 3\overline{t_C}}{\overline{t_L} - \overline{t_C}} > 0$ and $\lambda \in [\lambda_c, \lambda_d]$, then $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^-} \leq 0$.

As the center and local agents have policy interests close to each other, there exists a PBE equilibrium in which $t_C \in [\underline{t_C}, \overline{t_C})$.

Corollary 1. If both $\Gamma(\lambda, \overline{t_C}) = 0$ and $\Gamma(\lambda, \overline{t_C}^+) = 0$ have two solutions. i.e.,

$\lambda_a = \min \Gamma^{-1}(0 \,|\, t_C = \overline{t_C}^+)$, $\lambda_b = \max \Gamma^{-1}(0 \,|\, t_C = \overline{t_C}^+)$ and $\lambda_c = \min \Gamma^{-1}(0 \,|\, t_C = \overline{t_C})$, $\lambda_d = \max \Gamma^{-1}(0 \,|\, t_C = \overline{t_C})$ all exist, then $\lambda_a < \lambda_c < \lambda_d < \lambda_b$.

Proposition 3. If there is a $\lambda \in [\lambda_c, \lambda_d]$ satisfying $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^-} \leq 0$, then for any

$t_R \in [\underline{t_C}, \overline{t_C})$, there exist a unique $\underline{\lambda} \in (\lambda_a, \lambda_c)$ and $\overline{\lambda} \in (\lambda_d, \lambda_b)$. For any $\lambda \in (\underline{\lambda}, \overline{\lambda})$, $t_B(\lambda) = \Gamma^{-1}(0 \,|\, \lambda) \in (\overline{t_C}, \overline{t_L})$ is the ruler's unique equilibrium strategy; for any $\lambda \in (0, \underline{\lambda}) \cup (\overline{\lambda}, +\infty)$, $t_A(\lambda) = \max\{\Gamma^{-1}(0 \,|\, \lambda), t_R]$ is the ruler's unique equilibrium strategy; for $\lambda = \underline{\lambda}$ or $\lambda = \overline{\lambda}$, both $t_A(\lambda)$ and $t_B(\lambda)$ are the ruler's equilibrium strategy.

This proposition actually implies as λ is getting close to λ_c or λ_d, $t_A(\lambda)$ must be getting close to $\overline{t_C}$. So $t_B(\lambda)$ is going to be the ruler's equilibrium strategy in this situation. On the other hand, $t_A(\lambda)$ is definitely preferred to $t_B(\lambda)$ as λ is getting close to λ_a or λ_b. As $E(\lambda)$, the total tax expectation is continuous derivative, there must be existing two λs which make the ruler indifferent between $t_A(\lambda)$ and $t_B(\lambda)$. Certainly, here one special case $t_R = \overline{t_C}$ is excluded from the analysis. As I have mentioned before,

$t_C = t_R = \overline{t_C}$ can be the unique equilibrium strategy if and only if $\left. \dfrac{dE(t)}{dt_C} \right|_{t_C = \overline{t_C}^+} \geq 0$,

otherwise $t_B(\lambda)$ will be the unique equilibrium strategy.

As is seen on the Figure 3, if $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^-} = 0$ then

$$\lambda_c = \lambda_d == \frac{2}{\overline{t_C} - \underline{t_C}} \times \ln \frac{(\overline{t_L} - \overline{t_C})^2}{2(\overline{t_L} - \underline{t_L})(\overline{t_C} - \underline{t_C})}. \text{ In this case, } t_A(\lambda) = \overline{t_C}.$$

Figure 3. Monitoring Efficiency and Equilibrium Policy
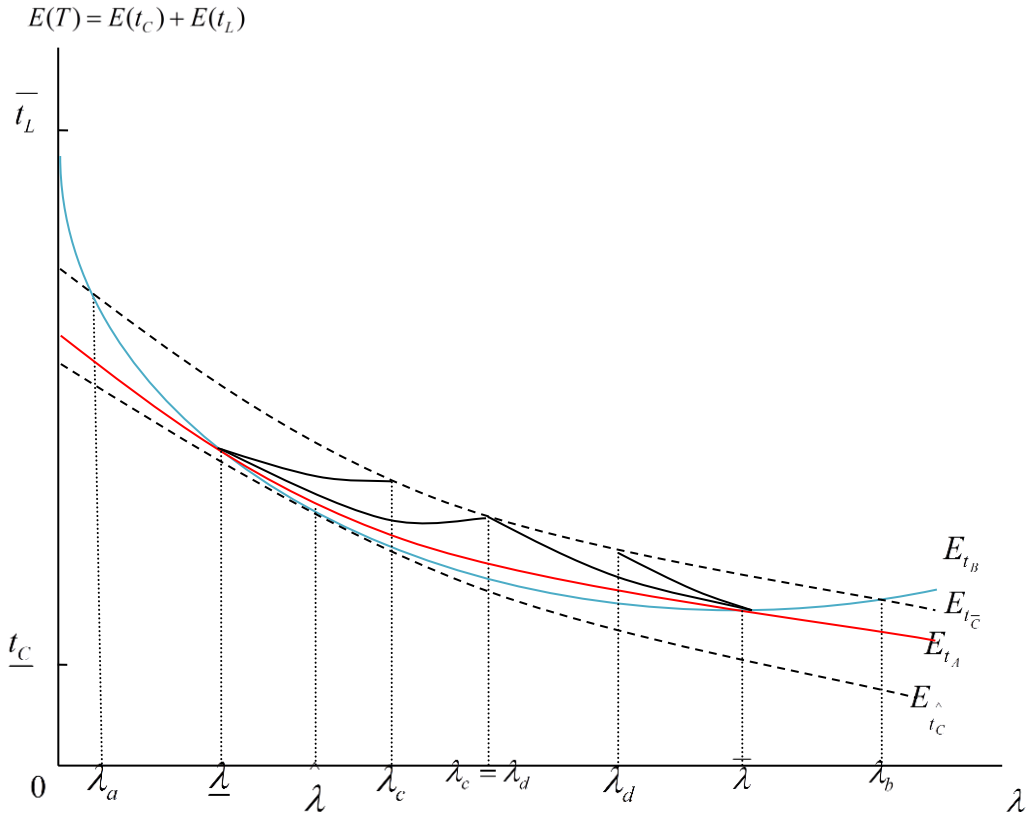
Now let's focus on $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^-} > 0$ and $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^+} < 0$. In this situation, we can always find under some conditions there are multiple equilibria in which $t_B(\lambda)$, a high level equilibrium strategy is preferred. For instance, if t_R is very large and close to

$\overline{t_C}$, then $E_{t_A}(\lambda)$ and $E_{t_B}(\lambda)$ will have two intersections on (λ_a, λ_b). In the previous

analysis, we have seen to make $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^+} \geq 0$ is very difficult in a large rural country

since the local officials generally have their comparative advantages in asymmetric information. Therefore a crucial problem is whether the central government can play

$t_A(\lambda)$ and keep the tax expectation at a low level given that $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^+} < 0$.

Proposition 4. Suppose $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^-} > 0 > \left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^+}$. The ruler would always play

$t_A(\lambda) = \max\{\Gamma^{-1}(0 \mid \lambda), t_R\}$ for any $\lambda \in (0, +\infty)$ if and only if there exists a unique

$\hat{t_C} \in (\max t_A(\lambda), \overline{t_C})$ which makes $E_{\hat{t_C}}(\hat{t_C}, \lambda)$ has a single tangent point with

$E_{t_B}(t_B(\lambda), \lambda)$, where $E_{\hat{t_C}}(\hat{t_C}, \lambda)$ and $E_{t_B}(t_B(\lambda), \lambda)$ are the total tax expectation under

the ruler's strategy of $t_C = \hat{t_C}$ and $t_C = t_B(\lambda)$ respectively.

Proposition 5. There is no Partial Pooling Equilibrium in this game

Assume there is a partial pooling equilibrium in which the ruler divides the policy space into two partitions and will send t_1 with $m(t_1)$ if $t_R \sim U[\underline{t_C}, \theta)$, t_2 with $m(t_2)$ if

$t_R \sim U[\theta, \overline{t_C}]$ where t_1 and t_2 are the ruler's tax policies on $[\underline{t_C}, \overline{t_L}]$. As a second mover, no matter what strategy the ruler is going to play, the local agents' best response is always playing:

$$t_L = \begin{cases} 0 & \text{if } t_L^* \leq t_C \\ e^{\lambda[E(t_R \mid m(t_C)) - t_C]} \times (t_L^* - t_C) & \text{if } t_C < t_L^* \end{cases}$$

So the total tax expectation is going to be

$$E(T) = E(t_C) + E(t_L) = \begin{cases} t_C & \text{if } t_L^* \leq t_C \\ t_C + e^{\lambda[E(t_C^* \mid m(t_C)) - t_C]} \times [E(t_L^*) - t_C)] & \text{if } t_C < t_L^* \end{cases}$$

Obviously, under a partial pooling equilibrium, the ruler cannot send $t_2 < \overline{t_C}$. So

$$E_{t_2}(t_2(\lambda), \lambda) = t_2 + \frac{(\overline{t_L} - t_2)^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda(\theta + \overline{t_C} - 2t_2)}{2}} \quad \text{and } t_2 \in [\overline{t_C}, \overline{t_L}]$$

Similarly, under a partial pooling equilibrium, the ruler cannot send $t_1 \geq \overline{t_C}$ or $t_1 < \theta$.

$$E_{t_1}(t_1(\lambda), \lambda) = \begin{cases} t_1 + \dfrac{(\overline{t_L} - t_1)^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda(\overline{t_C} + \theta - 2t_1)}{2}} & \text{if } \max\{\theta, \underline{t_L}\} \leq t_1 \leq \overline{t_C} \\[4mm] t_1 + \dfrac{\underline{t_L} + \overline{t_L} - 2t_1}{2} \times e^{\frac{\lambda(\overline{t_C} + \theta - 2t_1)}{2}} & \text{if } \theta \leq t_1 \leq \underline{t_L} \end{cases}$$

$$\frac{dE(t_C)}{dt_C} = \begin{cases} 1 - \dfrac{2(\overline{t_L} - t_2) + \lambda(\overline{t_L} - t_2)^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda(\theta + \overline{t_C} - 2t_2)}{2}} & \text{if } t_C = t_2 \\[4mm] 1 - \dfrac{2(\overline{t_L} - t_1) + \lambda(\overline{t_L} - t_1)^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda(\overline{t_C} + \theta - 2t_1)}{2}} & \text{if } \max\{\theta, \underline{t_L}\} \leq t_C = t_1 \leq \overline{t_C} \\[4mm] 1 - [1 + \dfrac{\lambda(\underline{t_L} + \overline{t_L} - 2t_1)}{2}] \times e^{\frac{\lambda(\overline{t_C} + \theta - 2t_1)}{2}} & \text{if } \theta \leq t_C = t_1 \leq \underline{t_L} \end{cases}$$

$$\frac{d^2 E(t_C)}{dt_C^2} > 0 \text{ for any } t_C \in [\theta, \overline{t_L}]$$

In this partial pooling game, $\overline{t_C}$ is not a discontinuous point of $\dfrac{dE(t_C)}{dt_C}$ any more. If

$\dfrac{dE(t_C)}{dt_C}\Big|_{t_C = \overline{t_C}} > 0$, then $t_2 = \overline{t_C}$ and there is no such a θ existing that can make the ruler

indifferent between t_1 and t_2; if $\dfrac{dE(t_C)}{dt_C}\Big|_{t_C = \overline{t_C}} = 0$, then $t_1 = t_2 = \overline{t_C}$ and this is not a partial

pooling strategy any more. $\dfrac{dE(t_C)}{dt_C}\Big|_{t_C = \overline{t_C}} < 0$ then $t_1 = \overline{t_C}$ and again there is no such a θ

existing that can make the ruler indifferent between t_1 and t_2. The above conclusion can be applied to any partial pooling game. So there is no Partial Pooling Equilibrium in this game.

Comparative Statics

1. Land Distribution

A war is often a way to redistribute land. In the history, the collapse of a Chinese dynasty took one of the three forms: peasants' revolts, foreign nation's invasions, and officials' rebels. A grassroots revolution may have a more significant impact on the distribution of land than other types of dynasty substitution. Specifically speaking, if a new dynasty is built on a peasant war, the initial land distribution in the new regime would be more likely close to an even distribution than those built on an interstate war or official rebels. Certainly, the wealth gap exists in any dynasties but those initialized by a peasant war are expected to live longer.

Proposition 6.

Assume $F(s)$ and $G(s)$ are two initial land distributions on $[\underline{s}, \bar{s}]$. If for any $s \in (\underline{s}, \bar{s})$ we have $F(s) > G(s)$ which implies that there are more peasants in the risk of losing their land in the society with land distribution $F(s)$, then given a tax profile (t_C, t_L) the society with land distributions $G(s)$ would be comparatively more stable. i.e., $x_G^*(s_G^* \mid G(s), t_C, t_L) \geq x_F^*(s_F^* \mid F(s), t_C, t_L)$. See Figure 4.

Figure 4. The Initial Distribution of Land and The Regime Stability
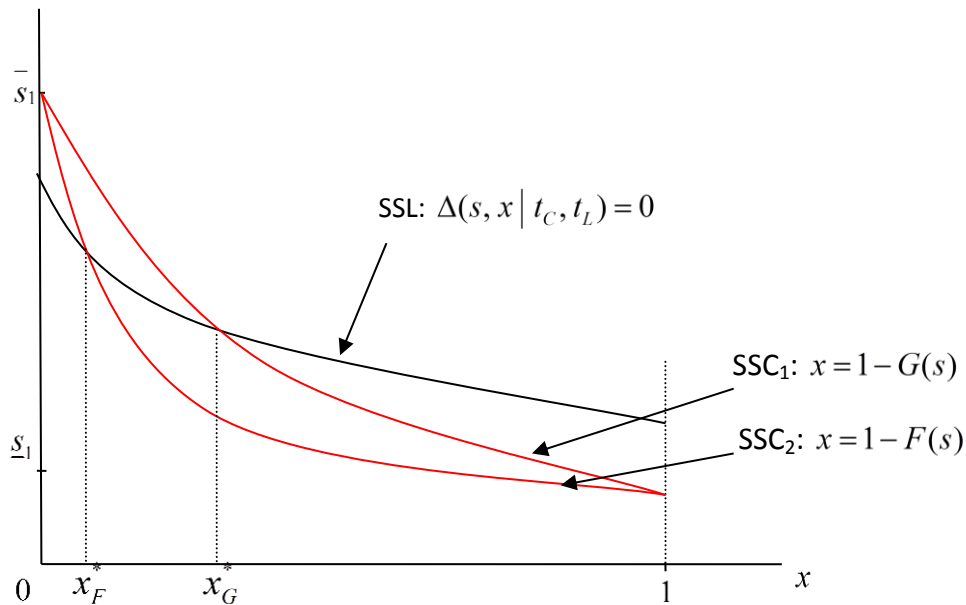
Another possible outcome introduced by a peasant war is that the initial distribution may be more "compact". Assume there are two types of initial land distributions. In type

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1, the dynasty is initialized by a peasant war and the land size, s follows a distribution with a pdf $f_1(s)$ on $[\underline{s_1}, \overline{s_1}]$. In type 2, the dynasty is initialized by a official rebel or interstate war and the land size, s follows a distribution with a pdf $f_2(s)$ on $[\underline{s_2}, \overline{s_2}]$. $\overline{s_2} > \overline{s_1} > \underline{s_1} > \underline{s_2}$. Figure 4 demonstrates the dynamic of land distributions and regime security under the government tax constraints. As $T = t_C + t_L$ increases, the income gap within the type I dynasty expands, and the distribution of land under type I dynasty began to transform gradually to a type II one.

From $\Delta(s, x \mid t_C, t_L) = [1 - T - (1 - \omega(x^*))t_w]gs^* - m = 0$

$$\frac{d\omega(x^*)}{dT} = \frac{1}{t_w(1 + \dfrac{m}{t_w gs^{*2} \times \dfrac{ds^*}{dx^*} \times \dfrac{dx^*}{d\omega(x^*)}})}$$

For a type I dynasty: $\dfrac{d\omega(x^*)}{dT} = 0$ if $T \in [0, 1 - \dfrac{m}{g\,\underline{s_1}}]$;

$$\frac{d\omega(x^*)}{dT} < 0 \text{ if } T \in (1 - \frac{m}{g\,\underline{s_1}}, 1 - t_w - \frac{m}{g\,\overline{s_1}}]$$
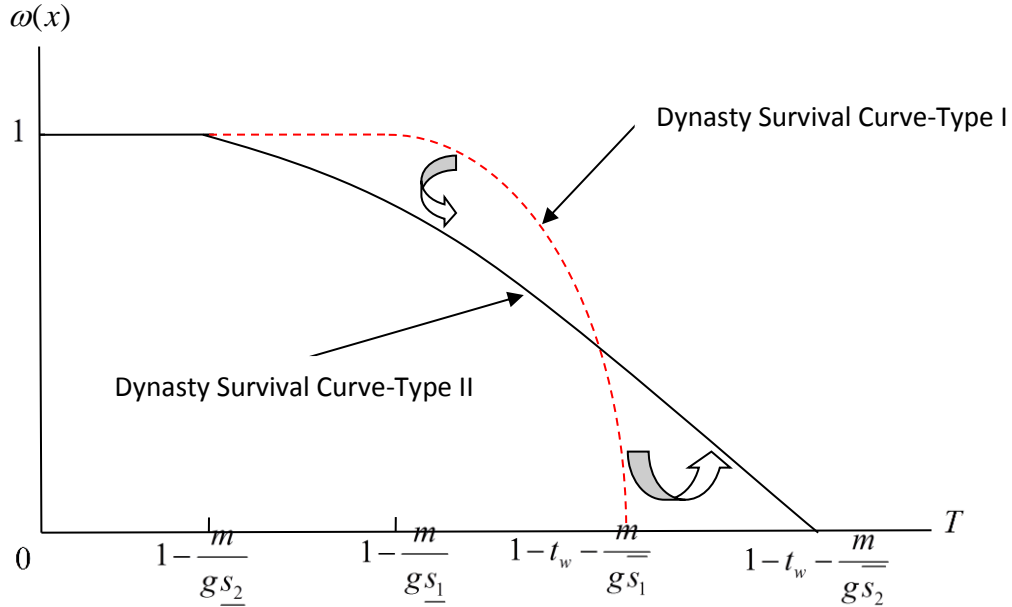
For a type II dynasty: $\dfrac{d\omega(x^*)}{dT} = 0$ if $T \in [0, 1 - \dfrac{m}{g\,\underline{s_2}}]$;

$$\frac{d\omega(x^*)}{dT} < 0 \text{ if } T \in (1 - \frac{m}{g\,\underline{s_2}}, 1 - t_w - \frac{m}{g\,\overline{s_2}}]$$

Figure 5. Tax Policy, Land Distribution and Dynasty Survival Curve

2. Local Agents' Belief

In the model , t_R , the central government's reservation tax has limited influence on the total tax rate as long as t_R is not very large. Several proposition have also shown that if λ , the monitoring efficiency factor is large enough, then the local agents behavior will not be a big concern of the central government. As we can imagine, collecting information would be very costly and inefficient in a large ancient country. When λ is fixed at a low level, local agents' belief on the peasants will play a key role in determining the tax outcome and thus the regime stability especially in a dynamic framework. In the static model, the local officials' idea policy t_L^* is derived from their belief on the peasants' economic threshold m_L . However, the local bureaucrats may not care about the regime security over the long run as the emperor does since the office positions generally cannot be inherited. Therefore, once the local bureaucrats observe there is no revolt in the current stage, t_L^* is more likely to goes up in the next stage. Consequently, the total tax burden in a central autocratic system always has a tendency to increase.

$$\frac{dE(T^*)}{d\overline{t_L}} = \begin{cases} \dfrac{1}{2}e^{\frac{\lambda(t_{\underline{C}}-t_C)}{2}} > 0 & if\ t_R \le t_C \le t_{\underline{L}} \\[3mm] \dfrac{(\overline{t_L}-t_C)(\overline{t_L}-2t_{\underline{L}}+t_C)}{2(\overline{t_L}-t_{\underline{L}})^2} \times e^{\frac{\lambda(t_{\underline{C}}-t_C)}{2}} > 0 & if\ t_{\underline{L}} < t_C \le \overline{t_C} \\[3mm] \dfrac{(\overline{t_L}-t_C)(\overline{t_L}-2t_{\underline{L}}+t_C)}{2(\overline{t_L}-t_{\underline{L}})^2} \times e^{\frac{\lambda(\overline{t_C}+t_{\underline{C}}-2t_C)}{2}} > 0 & if\ \overline{t_C} < t_C \le \overline{t_L} \end{cases}$$

Define $H_1(\overline{t_L}) = \ln\dfrac{(\overline{t_L}-\overline{t_C})^2}{(\overline{t_L}-t_{\underline{L}})(\overline{t_C}-t_{\underline{C}})} - \dfrac{\overline{t_L}+t_{\underline{C}}-2\overline{t_C}}{\overline{t_L}-\overline{t_C}}$

$H_1'(\overline{t_L}) = \dfrac{(\overline{t_L}-\overline{t_C})(\overline{t_L}+\overline{t_C}-2t_{\underline{L}})-(\overline{t_C}-t_{\underline{C}})(\overline{t_L}-t_{\underline{L}})}{(\overline{t_L}-t_{\underline{L}})(\overline{t_L}-\overline{t_C})^2} > 0$

Define $H_2(\overline{t_L}) = \ln\dfrac{(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-t_{\underline{L}})(\overline{t_C}-t_{\underline{C}})} - \dfrac{\overline{t_L}+2t_{\underline{C}}-3\overline{t_C}}{\overline{t_L}-\overline{t_C}}$

$H_2'(\overline{t_L}) = \dfrac{(\overline{t_L}-\overline{t_C})(\overline{t_L}+\overline{t_C}-2t_{\underline{L}})-2(\overline{t_C}-t_{\underline{C}})(\overline{t_L}-t_{\underline{L}})}{(\overline{t_L}-\overline{t_C})^2(\overline{t_L}-t_{\underline{L}})} > 0$ if $\dfrac{\overline{t_L}-\overline{t_C}}{\overline{t_L}-t_{\underline{C}}} > \dfrac{2(\overline{t_C}-t_{\underline{C}})}{\overline{t_C}-t_{\underline{L}}}$

Obviously, as $\overline{t_L}$ increases, proposition 2a and 2b is more likely to be true. This implies if $\overline{t_L}$ is large enough, then there is no room left for ruler to select a low level policy and the total tax rate will be increased rapidly.

Figure 6 Local Agents Behavior and Equilibrium Policy

$$E(T) = E(t_C) + E(t_L)$$
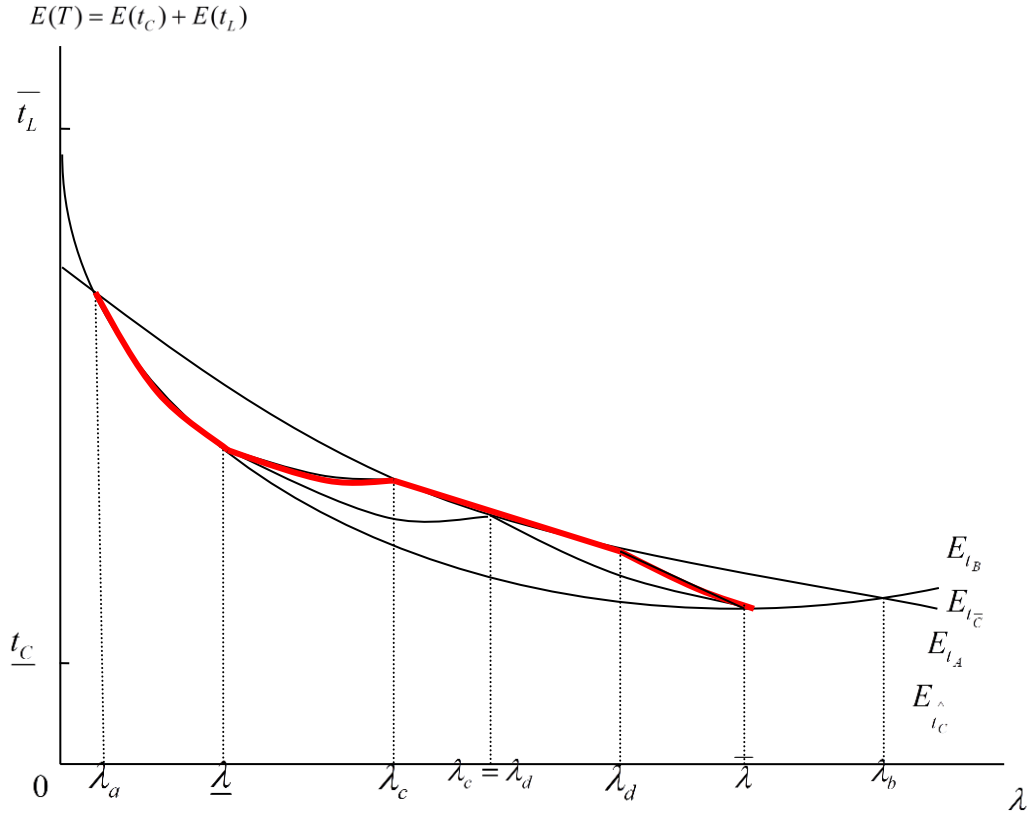
Peasants Revolts and Chinese Dynasties in the History

From 221B.C. to 1911, except Three Kingdoms (A.D. 220-280), Southern and Northern dynasties (A.D. 420-588), Five Dynasties and Ten Kingdoms (A.D. 907-979), China was governed as a unified country and experienced about 12 dynasties. As I have pointed in the beginning, one of the most distinguished characteristics of these dynasties is the new dynasties always inherited the previous political and economic institutions, but the variance of the ruling years among the dynasties is very large (See Table 1 and Figure 7, 8). If there was a large scale peasant war before a dynasty was established, it was generally expected a longer life—compared to a dynasty which was established on an interstate war.

In detail, Figure 7 delineates the relationship between the ruling years of each dynasty and its cause of establishment. Totally, there are twelve unified dynasties in the past twenty centuries, ranging from the early Qin Dynasty to the last Qing Dynasty. These dynasties vary according to their ruling years and causes of establishment. The y-axis describes the ruling years of each dynasty, from 14 years (Qin) to 289 years (Tang) with the mean of 156 years and the standard deviation of 97 years, respectively. The x-axis lists the twelve dynasties, categorized by two leading causes of establishment. The

first cause is related to interstate war, which plays decisive roles in the formation of seven dynasties including Qin, Western Jin, Eastern Jin, Sui, Northern Song, Southern Song and Yuan. The second cause is related to peasant revolt, which determines the formation of five dynasties including Western Han, Eastern Han, Tang, Ming and Qing. The vertical line split this graph into two parts with seven dynasties on the left and five dynasties on the right. The breakdown structure is important to understand the impact of cause of establishment on governance of each dynasty. First, the average ruling years caused by interstate war is shorter than that caused by peasant revolt. On average, the seven dynasties formed on the basis of interstate war didn't last long (Mean=87 years; Std.=57 years) while the five dynasties established on the basis of peasant revolt lasted much longer (Mean=251 years; Std.=38 years). Second, the two leading causes produce different land distributions. If the dynasty is built upon the interstate war which only transfers the highest power from the defeating emperor to the winning emperor, its influence on the land distribution of the mass might be limited. In contrast, if the dynasty is built upon peasant revolt, it will dramatically transform the society and redistribute land from the rich to the poor.

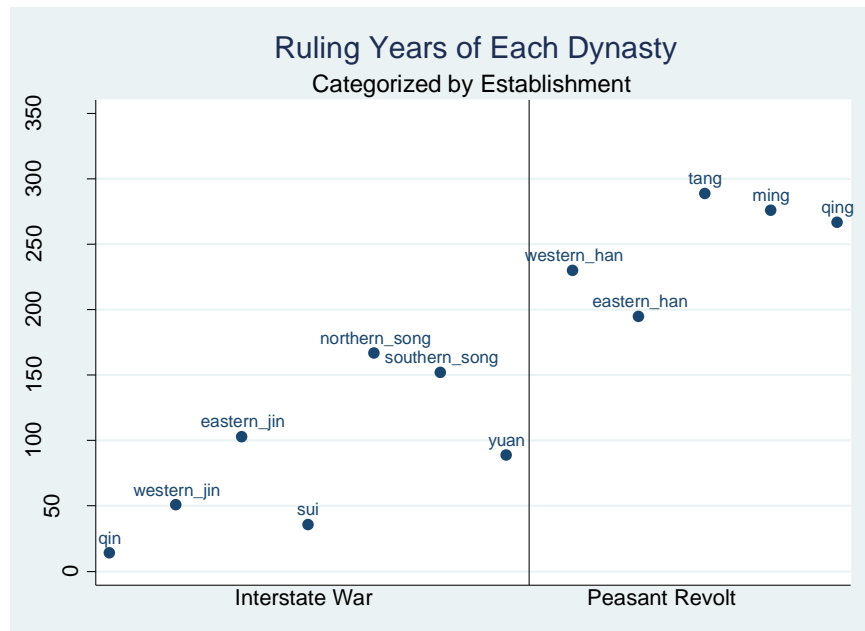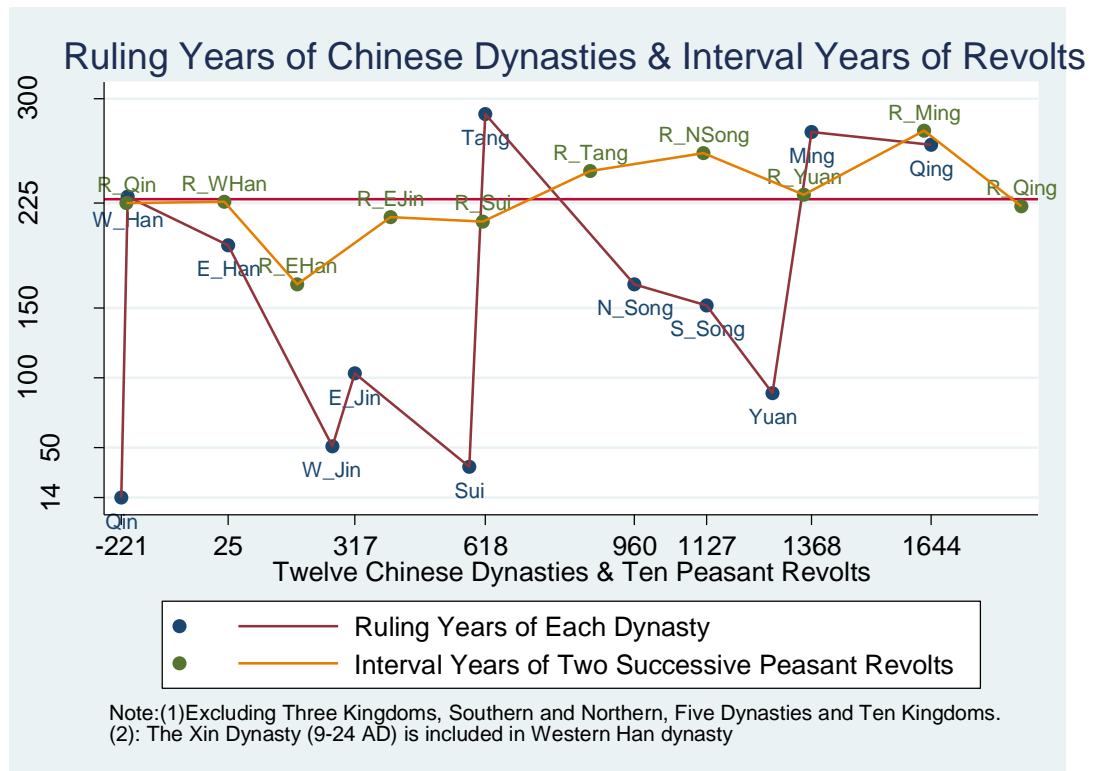**Figure 7. Ruling Years and The Establishment of Chinese Dynasties**

Figure 8 presents the descriptive characteristics for total ruling years of each dynasty and the interval years between two successive peasant revolts in pre-modern China. Based on this empirical evidence shown on Figure 8, it's more likely that there was a peasants' revolt cycle rather than the Dynastic Cycle.

In Figure 8, the red curve displays the trend of the total ruling years of twelve Chinese dynasties; and the orange curve displays the trend of interval years for two consecutive peasant revolts. The x-axis lists the starting years of twelve dynasties, ranging from 221 B.C. of Qin dynasty to 1644 A.D. of Qing dynasty. The y-axis describes total years and means differently for the two curves: total ruling years for the red curve and total interval years of two consecutive peasant revolts for the orange curve. Two tendencies are observed. First, there is wide variation with regards to total ruling years among twelve Chinese dynasties. Qin dynasty had the shortest life expectancy of 14 years, and Tang was the longest dynasty with 289 years. The mean length of twelve dynasties was 155.75 years with a standard deviation of 97 years. Second, the total interval years of two consecutive peasant revolts oscillate around its mean with a much smaller standard deviation. For the time period covering the twelve dynasties, there occurred ten influential peasant revolts. I calculate the interval years between two successive rebellions. Out of the ten data points, the mean distance between two succeeding revolts is 228 years, and the standard deviation is 30 years.

The sharp contrast between the two variations in Figure 8 implies two historical trends. (1) The well-known dynastic cycle is indeed a cycle of peasant revolt. Although the recurring phenomenon of dynastic cycle is characterized by prosperity of a new line of emperors in the beginning and misery of last emperor, it is in fact a manifestation of a cycle of peasant revolts. Over the two thousand years, the major peasant revolt occurred every two hundred years (mean=228 years). (2) The cycle of peasant revolt is indeed determined by the underlying change in land distribution. As mentioned earlier, the majority of the population in pre modern China was peasants who were trapped in the agricultural sector and had little alternative earning opportunities. Once the land annexation accumulated to an intolerable level and many peasants become landless, the demand for equal land distribution triggered civil war and put the old dynasty into an end. In sum, throughout two thousand years of CAS, land reforms were driving forces of Chinese dynastic cycle, which can be better represented as a cycle of peasant revolts.

Figure 8. The Chinese Dynasties and The Peasants Revolts Cycle

Ruling Years of Chinese Dynasties & Interval Years of Revolts

Twelve Chinese Dynasties & Ten Peasant Revolts

- Ruling Years of Each Dynasty
- Interval Years of Two Successive Peasant Revolts

Note:(1)Excluding Three Kingdoms, Southern and Northern, Five Dynasties and Ten Kingdoms.
(2): The Xin Dynasty (9-24 AD) is included in Western Han dynasty

Land and Taxation Reforms in Imperial China

Throughout imperial China history, there are seven major land reforms, namely Emperor Han Wudi Reform in Han Dynasty, Wang Anshi's Green Sprout Law in Song Dynasty, and Zhang Juzheng's Single Whip reform in Ming Dynasty.

The period governed by Emperor Han Wudi was one of the most prosperous times in Chinese history and the Silk Road became known worldwide. He was the first emperor who unified China in terms of ideology. In his term, he rejected the other schools of thought and made Confucianism as the state ideology. However, land annexation was prevalent during his governance and caused by two pieces of land policies. (1) According to state land policy, land taxes were based on the sizes of fields instead of on income. Peasants had to pay land taxes regardless of crop harvest. With the rural population growing, a shortage of land became developed. As crop harvest was heavily dependent on weather conditions and national disasters were frequent at that time, poor peasants had to borrow at usurious rates to pay their taxes. Without paying back debts, farmers were evicted and lands were accumulating into a new class of landholding families. However, in order to seek cooperation from wealthy landowners to finance his military campaigns, Emperor Wudi chose to ignore land redistribution and didn't make effective policies to prevent it from worsening. (2) The wealthy was levied higher tax rates and the poor peasants were supposed to pay lower taxes. However, the gentry bureaucrats can easily have their land tax exempt by taking advantage of their office, and consequently ordinary

peasants had to pay a larger share of total taxes. The heavy tax burden of peasants often resulted in bankruptcy and selling lands to landlords. Although Wudi wanted peasants to prosper, he was often deceived by the gentry bureaucrats who governed at the local level. The land policy was doomed failure because of its opposition to economic interests of local officials and landlords.

The Green Sprouts Law (the law on Qing Miao), launched by Grand Councilor Wang Anshi in Song Dynasty, was also called crop loan program or agricultural loan policy. This law grew out of the needs of many peasants for small loans to keep their families from hunger in the spring while they wait for crop harvests in the fall. In doing so, the law tended to controlling annexation of land. The state set up crop loan bureaus all over the country, lent grain or cash to farmers at interest rates lower than commercial lenders, and collected payment after the harvest. However, the goal of the program shifted soon after its implementation. There are two ways to distort the program. First, local officials arbitrarily increased the rate of interest on the loans for the purpose of economic revenues. Although poor farmers were able to pay back initially, they went to bankruptcy with heavy debts, and many were in arrears. The Green Sprouts Law failed to help those peasants in despair. Second, since local officials were profit-driven, they made loans to the rich and collected payments from them. As a result, the program didn't help poor farmers and increase income inequality to a great deal.

The Single Whip Method, initiated by the skillful chancellor Zhang Juzhen in Ming Dynasty, was designed to unite land tax, poll tax and informal taxes into one formal state tax. This reform was aimed to encourage agricultural development by reducing tax burdens on peasants. In practice, all taxes must be paid in silver. Peasants were no longer allowed to pay taxes in kind, but instead had to purchase silver in order to do so. The huge increase in the demand for silver was supported by a large influx of silver from international trade with Spain Empire. The reform was suspended after the death of Zhang Juzheng and his followers.

Although all these reforms aimed at reducing peasants' burden imposed by local governments and reducing local corruption, none of them had a sustainable impact and many were short lived. More often, these reforms were associated with an initial reduction in tax burdens on peasants, and a subsequent resurgence in fees and labor, and these reforms led to an increase rather than a decrease in tax burdens on peasants in the long run. This phenomenon was systematically studied by a famous scholar Huang Zongxi in Qing Dynasty and named as "Huang Zongxi's Law" thereafter.

Here we can explain the "Huang Zongxi's Law" via Figure 9 based on the PBE model. Suppose the current tax burden E_{t_B} is the outcome of a high level policy, $t_B(\lambda) = \Gamma^{-1}(0|\lambda) \in (\overline{t_C}, \overline{t_L})$. The emperor decides to make a tax reform and believes the government expenditure can be reduced after a tax reform. Thus his expectation E_{t_B} will go down to E_{t_A}. However, this policy outcome is based on the assumption that the local officials do believe the reform will significantly reduce t_R and they won't change their beliefs on the possibility of a peasant revolt (i.e., $\overline{t_L}$ will not change.) If the reform fails

to reduce t_R as many scholars pointed out and local bureaucrats do not care about the long time regime stability, then $\overline{t_L}$ will go up. In this situation, the reform's effect actually just reduced the monitoring cost which will increase the total tax. As we can see in Figure 9, E_{t_B} actually moves to E_{t_A}' rather than E_{t_A}.

Figure 9. Huang Zongxi's Law
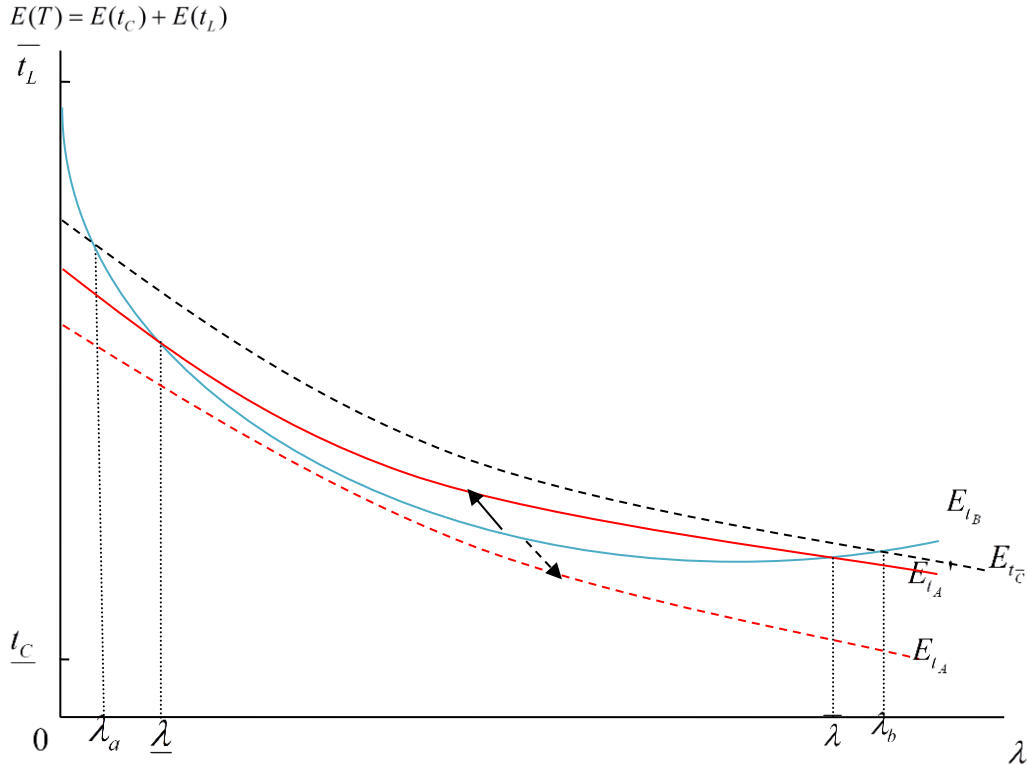
Conclusion

There is no dynastic cycle in the Chinese history but the peasants' revolt cycle.

Most Chinese dynasties collapsed during a peasant revolution, but a revolution does not necessarily mean the birth of a new dynasty. One of the most important consequences of a peasant war is that it greatly changed the distribution of the land in the country. So basically a new dynasty built after a grassroots revolt was expected to have a comparatively even land distribution across the country. In the model, this distribution is call social stability curve since it is this initial distribution heavily influenced the duration of the new dynasty. Under a central autocratic system, even though the emperor namely has the super authority and control everything, the ruler has to rely on its local agents and

landlord to maintain his administration. So the social stability curve is predetermined and hard to be transformed to benefit the poor peasants.

Based on these assumptions, a perfect Bayesian game is applied to analyze how difficult for the emperor to keep tax burden within a low level to avoid a peasant revolution. In a centralized system, the ruler usually does not have accurate information on the local bureaucrats' behavior. If the local agents do not care about the peasants economic interests as much as the central government, the total tax rate has a pressure to go up. Consequently, a large scale peasant revolt emerged in about every 225 years.

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Appendix:

Table 2: Timeline of the Chinese History

Sequence	Year	Dynasty	Sequence	Year	Dynasty
1	2000-1500 B.C.	Xia	15	A.D. 907-960	Five Dynasties
2	1700-1027 B.C.	Shang		907-923	Later Liang
3	1027-771 B.C.	Western Zhou		923-936	Later Tang
4	770-221 B.C.	Eastern Zhou		936-946	Later Jin
	770-476 B.C.	Spring and Autumn		947-950	Later Han
	475-221 B.C.	Warring States		951-960	Later Zhou
5	221-207 B.C.	Qin	16	A.D. 907-979	Ten Kingdoms
6	206 B.C.-A.D. 9	Western Han	17	A.D. 960-1279	Song
7	A.D. 9-24	Xin			
8	A.D. 25-220	Eastern Han	18	A.D. 916-1125	Liao
9	A.D. 220-280	Three Kingdoms	19	A.D. 1038-1227	Western Xia
	A.D. 220-265	Wei	20	A.D. 1115-1234	Jin
	221-263	Shu	21	A.D. 1279-1368	Yuan
	229-280	Wu	22	A.D. 1368-1644	Ming
10	A.D. 265-316	Western Jin	23	A.D. 1644-1911	Qing
11	A.D. 317-420	Eastern Jin	24	A.D. 1911-1949	Republic of China (in mainland China)
12	A.D. 420-588	Southern and Northern		A.D. 1949-	Republic of China (in Taiwan)
	420-588	Southern Dynasties	25	A.D. 1949-	People's Republic of China
	420-478	Song			
	479-501	Qi			
	502-556	Liang			
	557-588	Chen			
	386-588	Northern Dynasties			
	386-533	Northern Wei			
	534-549	Eastern Wei			
	535-557	Western Wei			
	550-577	Northern Qi			
	557-588	Northern Zhou			
13	A.D. 581-617	Sui			
14	A.D. 618-907	Tang			

Lemma1.

Proof:

(1) On the status switch line $\Delta(s, x \mid t_C, t_L) = 0$,

$$\frac{ds}{dx} = -\frac{\partial\Delta/\partial x}{\partial\Delta/\partial s} = -\frac{\omega'(x) \times t_w g s}{[1 - t_C - t_L - (1 - \omega(x))t_w]g}$$

By assumption, $\omega'(x) > 0$ so we have $\dfrac{ds}{dx} < 0$ on the status switch line.

$$\frac{d^2 s}{dx^2} = \frac{d\{-\dfrac{\omega'(x) \times t_w s}{[1 - t_C - t_L - (1 - \omega(x))t_w]}\}}{dx}$$

$$= -t_w \frac{\omega''(x)[1 - t_C - t_L - (1 - \omega(x))t_w]s - 2t_w s[\omega'(x)]^2}{[1 - t_C - t_L - (1 - \omega(x))t_w]^2} > 0$$

(2) On social stability curve $x = 1 - F(s(x))$, we have

$$1 = -f(s) \times \frac{ds}{dx} \Rightarrow \frac{ds}{dx} = -\frac{1}{f(s)} < 0$$

$$\frac{d^2 s}{dx^2} = \frac{d(-\dfrac{1}{f(s)})}{dx} = \frac{1}{f^2(s)} \times f'(s) \times \frac{ds}{dx}$$

Since there are more poor people than the rich in a society, usually we have $f'(s) < 0$ So $\dfrac{d^2 s}{dx^2} > 0$ on social stability curve.

Proposition 1.

Proof:

(1) If the tax policy profile (t_C, t_L) can satisfy $\Delta(\underline{s}, 1 \mid t_C, t_L) \geq 0$, then all the peasants would prefer to keep their land. This implies $x^* = 1$ is a Peasants' Equilibrium.

(2) If the tax policy profile (t_C, t_L) satisfies $\Delta(\underline{s}, 1 \mid t_C, t_L) < 0$ and $1 - t_C - t_L - t_w > 0$, then define $\Phi(x \mid t_C, t_L) = F^{-1}(1 - x) - \dfrac{m}{[1 - t_C - t_L - (1 - \omega(x))t_w]g}$.

$$\Phi(0 \mid t_C, t_L) = \bar{s} - \frac{m}{[1 - t_C - t_L - t_w]g} > 0$$

$$\Phi(1\,|\,t_C,t_L)=\underline{s}-\frac{m}{(1-t_C-t_L)g}<0$$

So there must be existing $x^*\in(0,1)$ which satisfies $\Phi(x^*\,|\,t_C,t_L)=0$. That is

$x^*=1-F(s^*)$ and $\Delta(s^*,x^*\,|\,t_C,t_L)=0$

Proposition 2a.

Proof:

$$\left.\frac{dE(T)}{dt_C}\right|_{t_C=\overline{t_C}^+}<0 \text{ if and only if } \Gamma(\lambda,\overline{t_C}^+)<0$$

$$\lim_{\lambda\to0^+}\Gamma(\lambda,\overline{t_C}^+)=1-\frac{\overline{t_L}-\overline{t_C}}{t_L-\underline{t_L}}=\frac{\overline{t_C}-\overline{t_L}}{\overline{t_L}-\underline{t_L}}>0$$

$$\lim_{\lambda\to+\infty}\Gamma(\lambda,\overline{t_C}^+)\to+\infty$$

$$\frac{\partial\Gamma(\lambda,\overline{t_C}^+)}{\partial\lambda}=\frac{\overline{t_C}-t_{\underline{C}}}{2}\times e^{\frac{\lambda(\overline{t_C}-t_{\underline{C}})}{2}}-\frac{(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-\underline{t_L})}$$

$$\frac{\partial^2\Gamma(\lambda,\overline{t_C}^+)}{\partial\lambda^2}=(\frac{\overline{t_C}-t_{\underline{C}}}{2})^2\times e^{\frac{\lambda(\overline{t_C}-t_{\underline{C}})}{2}}>0$$

$$\left.\frac{\partial\Gamma(\lambda,\overline{t_C}^+)}{\partial\lambda}\right|_{\lambda\to0^+}=\begin{cases}\dfrac{\overline{t_C}-t_{\underline{C}}}{2}-\dfrac{(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-\underline{t_L})}\geq0 & \text{if }(\overline{t_C}-t_{\underline{C}})(\overline{t_L}-\underline{t_L})\geq(\overline{t_L}-\overline{t_C})^2\\[3mm] \dfrac{\overline{t_C}-t_{\underline{C}}}{2}-\dfrac{(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-\underline{t_L})}<0 & \text{if }(\overline{t_C}-t_{\underline{C}})(\overline{t_L}-\underline{t_L})<(\overline{t_L}-\overline{t_C})^2\end{cases}$$

Let $\dfrac{\partial\Gamma(\lambda,\overline{t_C}^+)}{\partial\lambda}=\dfrac{\overline{t_C}-t_{\underline{C}}}{2}\times e^{\frac{\lambda(\overline{t_C}-t_{\underline{C}})}{2}}-\dfrac{(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-\underline{t_L})}=0$

$$\Longrightarrow \lambda=\frac{2}{\overline{t_C}-t_{\underline{C}}}\times\ln\frac{(\overline{t_L}-\overline{t_C})^2}{(\overline{t_L}-\underline{t_L})(\overline{t_C}-t_{\underline{C}})}$$

Take this λ into $\Gamma(\lambda,\overline{t_C}^+)=e^{\frac{\lambda(\overline{t_C}-t_{\underline{C}})}{2}}-\dfrac{2(\overline{t_L}-\overline{t_C})+\lambda(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-\underline{t_L})}$ and let

$$\Gamma(\lambda, \overline{t_C}^+) = e^{\frac{\lambda(\overline{t_C} - t_C)}{2}} - \frac{2(\overline{t_L} - \overline{t_C}) + \lambda(\overline{t_L} - \overline{t_C})^2}{2(\overline{t_L} - \underline{t_L})} < 0 \implies$$

$$\ln \frac{(\overline{t_L} - \overline{t_C})^2}{(\overline{t_L} - \underline{t_L})(\overline{t_C} - \underline{t_C})} > \frac{\overline{t_L} + \overline{t_C} - 2\overline{t_C}}{\overline{t_L} - \overline{t_C}}$$

$$(\overline{t_C} - \underline{t_C})(\overline{t_L} - \underline{t_L}) < (\overline{t_L} - \overline{t_C})^2 \iff \ln \frac{(\overline{t_L} - \overline{t_C})^2}{(\overline{t_L} - \underline{t_L})(\overline{t_C} - \underline{t_C})} > 0$$

$$(\overline{t_C} - \underline{t_C})(\overline{t_L} - \underline{t_L}) < (\overline{t_L} - \overline{t_C})^2 \implies$$

$$\frac{\overline{t_L} - \overline{t_C}}{\overline{t_C} - \underline{t_C}} - 1 > \frac{\overline{t_L} - \underline{t_L}}{\overline{t_L} - \overline{t_C}} - 1 \implies \frac{\overline{t_L} + \overline{t_C} - 2\overline{t_C}}{\overline{t_C} - \underline{t_C}} > \frac{\overline{t_C} - \underline{t_L}}{\overline{t_L} - \overline{t_C}} > 0$$

Therefore the condition for $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^+} < 0$ is going to be

$$\ln \frac{(\overline{t_L} - \overline{t_C})^2}{(\overline{t_L} - \underline{t_L})(\overline{t_C} - \underline{t_C})} > \frac{\overline{t_L} + \overline{t_C} - 2\overline{t_C}}{\overline{t_L} - \overline{t_C}} > 0 \text{ and } \lambda \in (\lambda_a, \lambda_b), \text{ where } \lambda_a \text{ and } \lambda_b \text{ are two solutions}$$

of $\Gamma(\lambda, \overline{t_C}^+) = 0$ given $\ln \dfrac{(\overline{t_L} - \overline{t_C})^2}{(\overline{t_L} - \underline{t_L})(\overline{t_C} - \underline{t_C})} > \dfrac{\overline{t_L} + \overline{t_C} - 2\overline{t_C}}{\overline{t_L} - \overline{t_C}} > 0$ and $\lambda_a < \lambda_b$.

If $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^+} \le 0$, the only possible equilibrium strategy in $(\overline{t_C}, \overline{t_L}]$ for the ruler is

to place $t_C = \Gamma^{-1}(0 | \lambda)$, $\Gamma^{-1}(0 | \lambda) \in (\overline{t_C}, \overline{t_L})$. Hence the ruler's idea strategy in this case is derived from $\Gamma(\lambda, t_C) = 0$. Since $\Gamma(\lambda, t_C)$ is monopoly increasing on $(\overline{t_C}, \overline{t_L}]$ as t_C goes up, for every $\lambda \in (\lambda_a, \lambda_b)$ there is a unique $t_C = \Gamma^{-1}(0 | \lambda) \in (\overline{t_C}, \overline{t_L})$. Let

$t_B(\lambda) = \Gamma^{-1}(0 | \lambda)$ be the ruler's optimal strategy on $(\overline{t_C}, \overline{t_L}]$ given $\left. \dfrac{dE(T)}{dt_C} \right|_{t_C = \overline{t_C}^+} < 0$.

Then the local agents are not able to update their belief on t_R and the total tax expectation in this case is going to be:

$$E(T) = E_{t_B}(\lambda) = t_B(\lambda) + \frac{\overline{t_L} - t_B(\lambda)}{\overline{t_L} - \underline{t_L}} \times e^{\frac{\lambda[t_C + \overline{t_C} - 2t_B(\lambda)]}{2}} \times [\frac{\overline{t_L} + t_B(\lambda)}{2} - t_B(\lambda)]$$

$$= t_B(\lambda) + \frac{[\overline{t_L} - t_B(\lambda)]^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda(t_C + \overline{t_C} - 2t_B(\lambda))}{2}}$$

If $\left.\dfrac{dE(T)}{dt_C}\right|_{tc=\overline{t_C}^-}>0$, the only possible equilibrium strategy on $[\underline{t_C},\ \overline{t_C}]$ for the ruler is

to place $t_C=\max\{\Gamma^{-1}(0\,|\,\lambda),t_R\}$. Define this optimal strategy on $[\underline{t_C},\ \overline{t_C}]$ as

$t_A(\lambda)=\max\{\Gamma^{-1}(0\,|\,\lambda),t_R\}$, where $\Gamma^{-1}(0\,|\,\lambda)\in(\underline{t_C},\ \overline{t_C})$. In this case the local agents are

able to update their belief on t_R according to the position of $t_C=t_A(\lambda)$ even though the

ruler won't reveal the exact position of t_R under his pooling strategy. The corresponding

total tax in this case will be:

$$E(T)=E_{t_A}(\lambda)=\begin{cases}t_A(\lambda)+\dfrac{t_L+\overline{t_L}-2t_A(\lambda)}{2}\times e^{\frac{\lambda(t_C-t_A(\lambda))}{2}} & \text{if } t_A(\lambda)\le \underline{t_L}\\[2em] t_A(\lambda)+\dfrac{[\overline{t_L}-t_A(\lambda)]^2}{2(\overline{t_L}-\underline{t_L})}\times e^{\frac{\lambda(t_C-t_A(\lambda))}{2}} & \text{if } \underline{t_L}<t_A(\lambda)\end{cases}$$

As we have discussed before, if $\left.\dfrac{dE(T)}{dt_C}\right|_{tc=\overline{t_C}^+}<\left.\dfrac{dE(T)}{dt_C}\right|_{tc=\overline{t_C}^-}\le 0$, then there is a

unique PBE in which t_C will be placed at $\Gamma^{-1}(0\,|\,\lambda)\in(\overline{t_C},\overline{t_L})$. Obviously, the condition

of $\left.\dfrac{dE(T)}{dt_C}\right|_{tc=\overline{t_C}^-}<0$ is supposed to be realized under a more strict one than that of

$\left.\dfrac{dE(t)}{dt_C}\right|_{tc=\overline{t_C}^+}<0$. This implies $\{\lambda\,|\,\left.\dfrac{dE(T)}{dt_C}\right|_{tc=\overline{t_C}^-}<0\}\subset(\lambda_a,\lambda_b)$.

Proposition 2b.

Proof:

$\left.\dfrac{dE(T)}{dt_C}\right|_{tc=\overline{t_C}^-}\le 0$ if and only if $\Gamma(\lambda,\overline{t_C})=e^{\frac{\lambda(\overline{t_C}-t_C)}{2}}-\dfrac{4(\overline{t_L}-\overline{t_C})+\lambda(\overline{t_L}-\overline{t_C})^2}{4(\overline{t_L}-\underline{t_L})}\le 0$

$\lim\limits_{\lambda\to 0^+}\Gamma(\lambda,\overline{t_C})=1-\dfrac{\overline{t_L}-\overline{t_C}}{t_L-\underline{t_L}}=\dfrac{\overline{t_C}-t_L}{t_L-\underline{t_L}}>0$

$\lim\limits_{\lambda\to+\infty}\Gamma(\lambda,\overline{t_C})\to+\infty$

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$$\frac{\partial \Gamma(\lambda, \overline{t_C})}{\partial \lambda} = \frac{\overline{t_C} - t_{\underline{C}}}{2} \times e^{\frac{\lambda(\overline{t_C} - t_{\underline{C}})}{2}} - \frac{(\overline{t_L} - \overline{t_C})^2}{4(\overline{t_L} - t_{\underline{L}})}$$

$$\frac{\partial^2 \Gamma(\lambda, \overline{t_C})}{\partial \lambda^2} = (\frac{\overline{t_C} - t_{\underline{C}}}{2})^2 \times e^{\frac{\lambda(\overline{t_C} - t_{\underline{C}})}{2}} > 0$$

$$\frac{\partial \Gamma(\lambda, \overline{t_C})}{\partial \lambda}\Big|_{\lambda \to 0^+} = \begin{cases} \frac{\overline{t_C} - t_{\underline{C}}}{2} - \frac{(\overline{t_L} - \overline{t_C})^2}{4(\overline{t_L} - t_{\underline{L}})} \geq 0 & \text{if } 2(\overline{t_C} - t_{\underline{C}})(\overline{t_L} - t_{\underline{L}}) \geq (\overline{t_L} - \overline{t_C})^2 \\ \frac{\overline{t_C} - t_{\underline{C}}}{2} - \frac{(\overline{t_L} - \overline{t_C})^2}{4(\overline{t_L} - t_{\underline{L}})} < 0 & \text{if } 2(\overline{t_C} - t_{\underline{C}})(\overline{t_L} - t_{\underline{L}}) < (\overline{t_L} - \overline{t_C})^2 \end{cases}$$

Let $\dfrac{\partial \Gamma(\lambda, \overline{t_C})}{\partial \lambda} = \dfrac{\overline{t_C} - t_{\underline{C}}}{2} \times e^{\frac{\lambda(\overline{t_C} - t_{\underline{C}})}{2}} - \dfrac{(\overline{t_L} - \overline{t_C})^2}{4(\overline{t_L} - t_{\underline{L}})} = 0$

$$\Longrightarrow \lambda = \frac{2}{\overline{t_C} - t_{\underline{C}}} \times \ln \frac{(\overline{t_L} - \overline{t_C})^2}{2(\overline{t_L} - t_{\underline{L}})(\overline{t_C} - t_{\underline{C}})}$$

Take it into $\Gamma(\lambda, \overline{t_C}) = e^{\frac{\lambda(\overline{t_C} - t_{\underline{C}})}{2}} - \dfrac{4(\overline{t_L} - \overline{t_C}) + \lambda(\overline{t_L} - \overline{t_C})^2}{4(\overline{t_L} - t_{\underline{L}})} \leq 0 \Longrightarrow$

$$\ln \frac{(\overline{t_L} - \overline{t_C})^2}{2(\overline{t_L} - t_{\underline{L}})(\overline{t_C} - t_{\underline{C}})} \geq \frac{\overline{t_L} + 2t_{\underline{C}} - 3\overline{t_C}}{\overline{t_L} - \overline{t_C}}$$

$$2(\overline{t_C} - t_{\underline{C}})(\overline{t_L} - t_{\underline{L}}) < (\overline{t_L} - \overline{t_C})^2 \Longleftrightarrow \ln \frac{(\overline{t_L} - \overline{t_C})^2}{2(\overline{t_L} - t_{\underline{L}})(\overline{t_C} - t_{\underline{C}})} > 0$$

$$2(\overline{t_C} - t_{\underline{C}})(\overline{t_L} - t_{\underline{L}}) < (\overline{t_L} - \overline{t_C})^2 \Longrightarrow \frac{\overline{t_L} + 2t_{\underline{C}} - 3\overline{t_C}}{\overline{t_L} - \overline{t_C}} > \frac{\overline{t_C} - t_{\underline{L}}}{(\overline{t_L} - t_{\underline{L}})} > 0$$

Therefore, when $\ln \dfrac{(\overline{t_L} - \overline{t_C})^2}{2(\overline{t_L} - t_{\underline{L}})(\overline{t_C} - t_{\underline{C}})} \geq \dfrac{\overline{t_L} + 2t_{\underline{C}} - 3\overline{t_C}}{\overline{t_L} - \overline{t_C}} > 0$ and $\lambda \in [\lambda_c, \lambda_d]$, we have

$$\frac{dE(T)}{dt_C}\Big|_{t_C = \overline{t_C}} \leq 0.$$

Corollary 3.

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Proof:

$$\Gamma(\lambda,\overline{t_C})-\Gamma(\lambda,\overline{t_C}^+)=e^{\frac{\lambda(\overline{t_C}-t_{\underline{C}})}{2}}-\frac{4(\overline{t_L}-\overline{t_C})+\lambda(\overline{t_L}-\overline{t_C})^2}{4(\overline{t_L}-t_{\underline{L}})}-e^{\frac{\lambda(\overline{t_C}-t_{\underline{C}})}{2}}+\frac{2(\overline{t_L}-\overline{t_C})+\lambda(\overline{t_L}-\overline{t_C})^2}{2(\overline{t_L}-t_{\underline{L}})}$$

$$=\frac{(\overline{t_L}-\overline{t_C})^2}{4(\overline{t_L}-t_{\underline{L}})}\times\lambda$$

$$\geq 0$$

Since $\overline{t_L}>\overline{t_C}$, so $\lambda=0$ is the only intersection of $\Gamma(\lambda,\overline{t_C})$ and $\Gamma(\lambda,\overline{t_C}^+)$. For any $\lambda>0$ we have $\Gamma(\lambda,\overline{t_C})>\Gamma(\lambda,\overline{t_C}^+)$. That is, $\lambda_a<\lambda_c<\lambda_d<\lambda_b$.

Now we can see for any $\lambda\in(0,\lambda_a]\cup[\lambda_b,+\infty)$, there is a unique pooling equilibrium in which $t_C=t_R$ if $\left.\frac{dE(T)}{dt_C}\right|_{t_C=t_R}\geq 0$ or $t_C=\Gamma^{-1}(0\,|\,\lambda)\in(t_R,\overline{t_C})$ if $\left.\frac{dE(T)}{dt_C}\right|_{t_C=t_R}<0$; while for any $\lambda\in[\lambda_c,\lambda_d]$, there is a unique pooling equilibrium in which $t_C=\Gamma^{-1}(0\,|\,\lambda)\in(\overline{t_C},\overline{t_L})$. On the interval $(\lambda_a,\lambda_c)\cup(\lambda_d,\lambda_b)$, the pooling equilibrium becomes a bit complicated.

Proposition 3.

Proof:

First notice it is easy to prove for any $\lambda\in(0,\lambda_a]\cup[\lambda_b,+\infty)$, $t_A(\lambda)$ is the unique pooling equilibrium strategy; for any $\lambda\in[\lambda_c,\lambda_d]$, $t_B(\lambda)$ is the ruler's unique pooling equilibrium strategy. Now let focus on $\lambda\in(\lambda_a,\lambda_c)\cup(\lambda_d,\lambda_b)$.

Define $\Delta E(\lambda)=E_{t_A}(\lambda)-E_{t_B}(\lambda)$, where $\lambda\in(\lambda_a,\lambda_c)\cup(\lambda_d,\lambda_b)$

$$\lim_{\lambda\to\lambda_a^+}\Delta E(\lambda)=E_{t_A}(\lambda_a)-t_B(\lambda_a)-\frac{[\overline{t_L}-t_B(\lambda_a)]^2}{2(\overline{t_L}-t_{\underline{L}})}\times e^{\frac{\lambda_a(t_{\underline{C}}+\overline{t_C}-2t_B(\lambda_a))}{2}}$$

$$=E_{t_A}(\lambda_a)-[\overline{t_C}+\frac{[\overline{t_L}-\overline{t_C}]^2}{2(\overline{t_L}-t_{\underline{L}})}\times e^{\frac{\lambda_a(t_{\underline{C}}-\overline{t_C})}{2}}]$$

$$<0$$

$$\lim_{\lambda \to \lambda_c^-} \Delta E(\lambda) = E_{t_A}(\lambda_c) - t_B(\lambda_c) - \frac{[\overline{t_L} - t_B(\lambda_c)]^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda_c(\underline{t_C} + \overline{t_C} - 2t_B(\lambda_c))}{2}}$$

$$= E_{t_A}(\lambda_c \mid \overline{t_C}) - t_B(\lambda_c) - \frac{[\overline{t_L} - t_B(\lambda_c)]^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda_c(\underline{t_C} + \overline{t_C} - 2t_B(\lambda_c))}{2}}$$

$$> 0$$

Hence there must be existing a $\underline{\lambda} \in (\lambda_a, \lambda_c)$ which satisfies

$$\Delta E(\underline{\lambda}) = E_{t_A} - E_{t_B} = E_{t_A}(\underline{\lambda}) - t_B(\underline{\lambda}) - \frac{[\overline{t_L} - t_B(\underline{\lambda})]^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\underline{\lambda}(\underline{t_C} + \overline{t_C} - 2t_B(\underline{\lambda}))}{2}} = 0$$

The proof of the uniqueness of $\underline{\lambda}$ is omitted here (Basically if there is another $\underline{\lambda}' \in (\lambda_a, \lambda_c)$ then $E_{t_A}(\lambda)$ will be a concave function in a small space around $\underline{\lambda}'$ which is contradicted with $E_{t_A}(\lambda)$ being convex on (λ_a, λ_c)). Similarly we can prove the existence and uniqueness of $\overline{\lambda}$.

Proposition 4.

Proof:

(1) If there exists a unique $\overset{\wedge}{t_C} \in (\max t_A(\lambda), \overline{t_C})$ which satisfies $E_{\overset{\wedge}{t_C}}(\overset{\wedge}{t_C}, \lambda)$ has a single tangent point with $E_{t_B}(t_B(\lambda), \lambda)$, then $E_{\overset{\wedge}{t_C}}(\overset{\wedge}{t_C}, \lambda)$ must be below the curve of $E_{t_B}(t_B(\lambda), \lambda)$ otherwise there are two intersections between them. This implies $E_{\overset{\wedge}{t_C}}(\overset{\wedge}{t_C}, \lambda) \le E_{t_B}(t_B(\lambda), \lambda)$.

Since $\overset{\wedge}{t_C} > \max t_A(\lambda)$, we have $\left. \frac{dE(T)}{dt_C} \right|_{t_C = \overset{\wedge}{t_C}} > \left. \frac{dE(T)}{dt_C} \right|_{t_C = t_A(\lambda)}$ and $E_{t_A}(t_A(\lambda), \lambda) < E_{\overset{\wedge}{t_C}}(\overset{\wedge}{t_C}, \lambda) \le E_{t_B}(t_B(\lambda), \lambda)$. Therefore, for any $\lambda \in (0, +\infty)$ $t_A(\lambda) = \max\{\Gamma^{-1}(0 \mid \lambda), t_R\}$ is the ruler's unique equilibrium strategy.

(2) If $t_A(\lambda) = \max\{\Gamma^{-1}(0 \mid \lambda), t_R\}$ is always the ruler's equilibrium strategy, then $E_{t_A}(t_A(\lambda), \lambda) < E_{t_B}(t_B(\lambda), \lambda)$ is true for any $\lambda \in (0, +\infty)$.

Mark $[a,b]=[t_A(\lambda),\overline{t_C}]$, $[c,d]=[\lambda_a,\lambda_b]$ and let $t_0=\dfrac{t_A(\lambda)+\overline{t_C}}{2}$. If $E_{t_0}(t_{t_0},\lambda)$ has a

single tangent point with $E_{t_B}(t_B(\lambda),\lambda)$, then the proposition is proved. If not, let

$t_1=\dfrac{t_A(\lambda)+t_0}{2}$, $\lambda_1=\dfrac{\lambda_0+\lambda_0'}{2}$ and mark $[a_1,b_1]=[a,t_1]$, $[c_1,d_1]=[\lambda_a,\lambda_1]$ if $E_{t_0}(t_{t_0},\lambda)$

has two intersections with $E_{t_B}(t_B(\lambda),\lambda)$ at $\lambda=\lambda_0$ and $\lambda=\lambda_0'$; Otherwise let

$t_1=\dfrac{t_0+\overline{t_C}}{2}$, $\lambda_1=\dfrac{\lambda_a+\lambda_b}{2}$ and $[a_1,b_1]=[t_1,\overline{t_C}]$, $[c_1,d_1]=[\lambda_1,\lambda_b]$ if $E_{t_0}(t_{t_0},\lambda)$ is strictly

below $E_{t_B}(t_B(\lambda),\lambda)$.

Substitute $[a_1,b_1]$ for $[a,b]$, $[c_1,d_1]$ for $[c,d]$ and repeat the above process. So
we find a series of subsets $[a_1,b_1]$, $[a_2,b_2]$, …, $[a_k,b_k]$ which satisfy
$[a,b]\supset[a_1,b_1]\supset[a_2,b_2]\supset...\supset[a_k,b_k]$, and $[c_1,d_1]$, $[c_2,d_2]$, …, $[c_k,d_k]$ which
satisfy $[c,d]\supset[c_1,d_1]\supset[c_2,d_2]\supset...\supset[c_k,d_k]$.

Take $t_k=\dfrac{a_k+b_k}{2}$ and $\lambda_k=\dfrac{c_k+d_k}{2}$. If $E_{t_k}(t_k,\lambda)$ has a single tangent point with

$E_{t_B}(t_B(\lambda),\lambda)$, then the proposition is proved. If not, repeat the previous procedure we
have $[a_{k+1},b_{k+1}]$ and $[c_{k+1},d_{k+1}]$.

Continue this process, there are two situations: either we find $\hat{t}_C=\dfrac{a_n+b_n}{2}$,

$\hat{\lambda}=\dfrac{c_n+d_n}{2}$ which satisfies the single tangent requirement (Easy to see it is impossible to

get two or more tangent points), or we find a series of closed sets $\{[a_n,b_n]\}$ satisfying

$[a,b]\supset[a_1,b_1]\supset[a_2,b_2]\supset...\supset[a_n,b_n]\supset...$ and $0<b_n-a_n=\dfrac{\overline{t_C}-t_A(\lambda)}{2^n}$,

and a series of closed sets $\{[c_n,d_n]\}$ satisfying

$[c,d]\supset[c_1,d_1]\supset[c_2,d_2]\supset...\supset[c_n,d_n]\supset...$ and $0<d_n-c_n=\dfrac{\lambda_b-\lambda_a}{2^n}$

According to close-nested interval theorem, there is a unique

$\hat{t}_C = \lim a_n = \lim b_n \in (t_A(\lambda), \overline{t_C})$ and unique $\hat{\lambda} = \lim c_n = \lim d_n \in (\lambda_a, \lambda_b)$. Since

$E(t_C, \lambda) = t_C + \dfrac{(\overline{t_L} - t_C)^2}{2(\overline{t_L} - \underline{t_L})} \times e^{\frac{\lambda(t_C - t_C)}{2}}$ is continuous on $[a, b]$ and $[c, d]$, we have

$E_{\hat{t_C}}(\hat{t_C}, \hat{\lambda}) = \lim E(a_n, c_n) = \lim E(b_n, d_n)$.

Now the unique $\hat{t_C} \in (\max t_A(\lambda), \overline{t_C})$ has been found. What we need to do is to prove

$E_{\hat{t_C}}(\hat{t_C}, \lambda)$ has a single tangent point with $E_{t_B}(t_B(\lambda), \lambda)$ at $\hat{\lambda}$. Since $E_{a_n}(a_n, \lambda)$ is

below $E_{t_B}(t_B(\lambda), \lambda)$ (no intersections) and $E_{b_n}(b_n, \lambda)$ is above $E_{t_B}(t_B(\lambda), \lambda)$ on $[c_n, d_n]$,

Notice $E_{t_B}(t_B(\lambda), \lambda)$ is decreasing as λ goes up, we have

$E_{a_n}(a_n, c_n) < E_{t_B}(t_B, d_n) < E_{t_B}(t_B, c_n) < E_{b_n}(b_n, d_n)$. Therefore :

$E_{\hat{t_C}}(\hat{t_C}, \hat{\lambda}) = \lim E(a_n, c_n) \le E_{t_B}(t_B, d_n) \le E_{t_B}(t_B, c_n) \le \lim E(b_n, d_n) = E_{\hat{t_C}}(\hat{t_C}, \hat{\lambda})$

So $E_{\hat{t_C}}(\hat{t_C}, \hat{\lambda}) = E_{t_B}(t_B, \hat{\lambda})$.

Note: the single point $(\hat{\lambda}, E_{\hat{t_C}}(\hat{t_C}, \hat{\lambda}))$ must be the tangent point of $E_{\hat{t_C}}(\hat{t_C}, \lambda)$ and

$E_{t_B}(t_B(\lambda), \lambda)$ rather than the intersection. Otherwise it is easy to prove there must be

existing another intersection point.

The implication of proposition 4 is straightforward but important. In fact, there

always exists a unique $\hat{t_C} \in (\underline{t_C}, \overline{t_C})$ (note $\hat{t_C}$ is not necessarily in $(\max t_A(\lambda), \overline{t_C})$) which

makes $E_{\hat{t_C}}(\hat{t_C}, \lambda)$ has a single tangent point with $E_{t_B}(t_B(\lambda), \lambda)$. If

$E_{t_A}(t_A(\lambda), \lambda) > E_{\hat{t_C}}(\hat{t_C}, \lambda)$, then even with $\left.\dfrac{dE(T)}{dt_C}\right|_{t_C = \overline{t_C}} > 0$ proposition 3 is still true and

for any $\lambda \in (\underline{\lambda}, \overline{\lambda})$, there is no low level central equilibrium policy.

Proposition 6.

Proof:

(1) if $x_F^*(s_F^* \mid F(s), t_C, t_L) = 1$, then

$$\Delta(\underline{s}, x^* = 1 \mid F(s), t_C, t_L) = (1 - t_C - t_L)g\underline{s} - m \geq 0$$

So $\Delta(\underline{s}, x = 1 \mid G(s), t_C, t_L) = (1 - t_C - t_L)g\underline{s} - m \geq 0$

This implies $x^*(\underline{s} \mid G(s), t_C, t_L) = 1$ is a peasants' equilibrium in the society with land

distributions $G(s)$ and $x_G^*(s_G^* \mid G(s), t_C, t_L) \geq x_F^*(s_F^* \mid F(s), t_C, t_L) = 1$.

(2) Suppose (x_F^*, s_F^*) is the peasants equilibrium in the society with land distribution

$F(s)$ and $x_F^* < 1$.

Define $\Phi_F(x \mid F(x), t_C, t_L) = F^{-1}(1 - x) - \dfrac{m}{[1 - t_C - t_L - (1 - \omega(x))t_w]g}$

$$\Phi_G(x \mid G(x), t_C, t_L) = G^{-1}(1 - x) - \dfrac{m}{[1 - t_C - t_L - (1 - \omega(x))t_w]g}$$

Since (x_F^*, s_F^*) is the peasants equilibrium and for any $s \in (\underline{s}, \bar{s})$ $F(s) > G(s)$, we

have $\Phi_F(x_F^* \mid F(x), t_C, t_L) = 0$ and $G^{-1}(1 - x_F^*) > F^{-1}(1 - x_F^*)$.

So $\Phi_G(x_F^* \mid G(x), t_C, t_L) = G^{-1}(1 - x_F^*) - \dfrac{m}{[1 - t_C - t_L - (1 - \omega(x_F^*))t_w]g} > 0$

From $x_F^* < 1$, we have $\Phi_F(1 \mid F(x), t_C, t_L) = \underline{s} - \dfrac{m}{[1 - t_C - t_L]g} < 0$.

So $\Phi_G(1 \mid F(x), t_C, t_L) = \underline{s} - \dfrac{m}{[1 - t_C - t_L]g} < 0$.

Hence there must be existing one $x_G^* \in (x_F^*, 1)$ which satisfies

$$\Phi_G(x_G^* \mid G(x), t_C, t_L) = G^{-1}(1 - x_G^*) - \frac{m}{[1 - t_C - t_L - (1 - \omega(x_G^*))t_w]g} = 0$$

Therefore, $x_G^*(s_G^* \mid G(s), t_C, t_L) \geq x_F^*(s_F^* \mid F(s), t_C, t_L)$

Chapter 3

Bureaucratic Corruption, Democracy and Judicial Independence

Section One: Introduction

Corruption, as government officials use public powers for private economic interests, has been the hot topic of debate among social scientists. Evidence of bureaucratic corruption exists in all economies, at various stages of development, and under different political and economic regimes. But why is it more pervasive in some societies than in others? Economists and political scientists have stressed the importance of such variables as economic development, government expenditure, democracy, checks and balances, etc. Comparatively very few scholars focus on the role of judicial system in shaping the patterns of bureaucratic corruption. Employing a formal model with empirical analyses, I incorporate economic factors with political constraints to investigate the different effects of democracy and judicial system on the level of corruption and argue the judiciary, as a hard institutional constraint to resist bureaucratic corruption, has to be independent from the government.

For most economists, corruptions lie in the delegation of power. Therefore, economic theories pay much attention to the decision of rational bureaucrats who involved in corrupt transactions. Under information asymmetry, the principal in many cases may not have full control over the agent's misconduct. Thus the agent can circumvent many of the checks and controls that are placed by the principal (Rose-Ackerman 1978). It is easier to explain the nature of corruption according to the failure of the principal-agent relationship. It is, however, unclear why officials in some countries misuse public office for private gain more frequently and for larger payoffs than their counterparts in others. Thus a principal-agent model has its limitations in explaining the level of corruption.

Many economists have also studied the empirical regularities between corruption and a variety of economic variables across the countries. Most of these studies report income (Damania et al. 2004; Lederman,et al. 2005; Treisman, 2000), government expenditure (Fishman and Gatti, 2002), and economic freedom (Goldsmith, 1999; Park, 2003; Treisman, 2000) have a negative-significant effect of the level of corruption. However, some economic factors like government expenditure which is significant in a particular model may lose their significance when some other political variables are incorporated. Hence as Seldadyo and Haan (2006) contend, "claims concerning the determinants of corruption are conditional, and the robustness of the findings is open to question."

Political scientists have been attempting to explain how political institutions influence actual corruption levels in different societies. The logic that political institutions play a key role in fighting bureaucratic corruption is reasonable and obvious. Because government intervention transfers resources from one party to another, it creates room for corruption (Acemoglu and Verdier, 2000). Since in a modern society it is unavoidable that the government frequently involves in economic activities, without any political constraints, government leaders can make full use of public resources for private benefits. In other words, without a strict punishment which can only be offered by political institutional arrangements, corruption will be out of control. But various political institutions may have very different effects on bureaucrats' corruption behavior. For

instance, under a judicial system, a corruptive bureaucrat will be punished severely based on solid evidence of his corruptive activities whereas under democratic system, a corruptive bureaucrat can only be punished via free press exposure and voting outcomes. Generally speaking, the actual level of corruption in a society should be determined by the strictest of institutional arrangements. Many comparative studies report a significant relationship between democracy and the level of corruption based on various regression approaches without controlling judicial independence. In my view, these empirical conclusions on the "*Democratic Clean Theory*" are theoretically and empirically problematic.

The structure of the rest part is organized as follows: in Section two, I am going to analyze the flawed logic and empirical paradox of *democratic clean theory*. In Section three, a formal model will be employed to investigate why the level of judicial independence rather than democracy has a significant impact to the level of corruption. My empirical evidence will be provided in Section four and the brief discussion and conclusion in the end.

Section Two: The Flawed Logic and Empirical Paradox of *Democratic Clean Theory*

Following the logic of the Principle-Agent Model, many political scientists argue that a democratic regime predicts a low level of corruption because electoral accountability enforces an efficient constraint to government officials and political competition and free press reduce information asymmetries between voters and bureaucrats (Lederman et al. 2005; Kunicova-R. Ackerman, 2005; Gurgur-Shah, 2005; Braun-Di Tella, 2004; Chang-Golden, 2004; Treisman, 2000; Ades-Di Tella 1997,1999; Goldsmith, 1999). Theoretically the corruption level of a country is determined by the most efficient political constraint to bureaucrats' misconduct. Thus the *democratic clean theory* is reasonable given that the democratic regime is the strictest of institutional arrangements. Unfortunately, thus far there is no literature articulately comparing the efficiency of democracy and that of judicial independence in term of fighting corruption. In addition, without a judicial intervention, whether electoral accountability and free press imply a high expected cost for the bureaucrat is in doubt. As Rose-Ackerman (1999) concluded, the distinctive incentives for corruption in democracies depend on the organization of electoral and legislative processes and on the methods of campaign finance[21]. Hence democratic elections are not invariably a cure for corruption.

The empirical evidence of a relationship between democracy and corruption is also mixed. While many regression analyses find that democracy has significant impacts on the level of corruption (Ferejohn 1986; Aidt and Dutta 2001; Emerson 2006; Lederman et al. 2001; Sandholtz and Koetzle 2000). A cross-national study by Treisman (2000) suggests that the current degree of electoral democracy is not significantly correlated with the level of corruption, but long exposure to democracy predicts lower corruption. Montinola and Jackman (2002) confirm that political competition affects levels of corruption, but this effect is nonlinear. Most of these studies employ OLS regression

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[21] By relating corruption to different features of the electoral system in a sample from the late nineties encompassing more than 80 democracies, Persson et al. (2001) find that larger voting districts are associated with less corruption, holding constant a variety of economic and social variables.

analyses without controlling the level of judicial independence. Since many measures of political institutions are highly associated with each other and endogenous relationships among aggregate level variables are very popular in social science research, the strategy of research design is crucial to the credibility of empirical results.

Because I am interested in not only the determinants of corruption from comparative perspective, but the causal mechanisms between bureaucrats' corruption behavior and institutional arrangements, I attempt to employ a formal model to further our understanding on bureaucratic corruption and then provide a robust empirical analysis.

Section Three: Corruption and Political Constraints

Under certain economic conditions, a bureaucrat's corruptive behavior is a rational decision based on cost-benefits consideration. Because political institutions define the rules of game in delegation of power, and anyone breaks the rules may be enforced a penalty, a bureaucrat should consider political constraints as corruptive action costs. We can observe how the bureaucrat searches for his perfect corruption level by analyzing his utility function.

Assume a bureaucrat's expected wage income was W_0 in time period t without corruption. With corruption his income in the two states, "no punishment" (W_1) and "punishment" (W_2), is $(W_0 + \alpha, W_0 + \alpha - \alpha_I)$, where α represents the benefits from corruption and α_I the punishment enforced by a political institution. Since not all corruptive activities can be monitored, the expected utility theorem suggests that his preferences for income in these two states are described by the following function,

$$V(p, W_1, W_2) = (1-p)U(W_1) + pU(W_2),$$

where $U()$ represents the utility of money income and p the probability of being punished. Bureaucrats' corruption behavior can be seen as a choice between different combinations of the potential corruption levels and punishments, which can be described by $V(p, \alpha, \alpha_I) = V(p, W_0 + \alpha, W_0 + \alpha - \alpha_I)$. From all the corruption-punishment choices the bureaucrat is offered, he chooses the one that maximizes $V(p, \alpha, \alpha_I)$. Since he always has the option of doing no corruption, a bureaucrat will select corruption only if $V(p, \alpha, \alpha_I) \geq V(p, 0, 0) = U(W_0)$, which implies that bureaucrats are willing to work in public sectors because they can enjoy high rents by using public offices or public sectors could offer an efficiency wage. I assume that bureaucrats are identical in all aspects and that they are risk-averse $(U'' < 0)$.

Suppose the amount of public resources he can corrupt is α_0. In Figure 1, let's try to understand a bureaucrat's behavior in this way: to gain the corrupt benefit α (on the horizontal axes), $0 \leq \alpha \leq \alpha_0$, he has to pay the cost of being punished α_I with probability p, so the expected cost will be $p \times \alpha_I$ (on the vertical axes). Assume his corrupt behavior will never be tolerated, so the probability of being detected is equal to the probability of being punished (see Note i for proof)[i]. If there are no institutioanl constraints, $p = 0, \alpha_I = 0, p \times \alpha_I = 0$, then $V(p, W_1, W_2) = U(W_0 + \alpha)$ and from $\dfrac{\partial U(W_0 + \alpha)}{\partial \alpha} > 0$, which implies he enjoys every dollar corrupted without paying any cost.

In figure 1, the rational bureaucrat will get started from point $N(W_0, W_0)$ and go along with the straight line NA until point $A(W_0 + \alpha_0, W_0 + \alpha_0)$ is reached. That is, the rational bureaucrat can maximize his utility under the initial budget line NA. At point $A(W_0 + \alpha_0, W_0 + \alpha_0)$, he makes full use of public resources for private gains and his utility in this circumstance is $V_A(p, W_1, W_2) = (1 - p)U(W_1) + pU(W_2) = U(W_1) = U(W_0 + \alpha_0)$

Figure 1
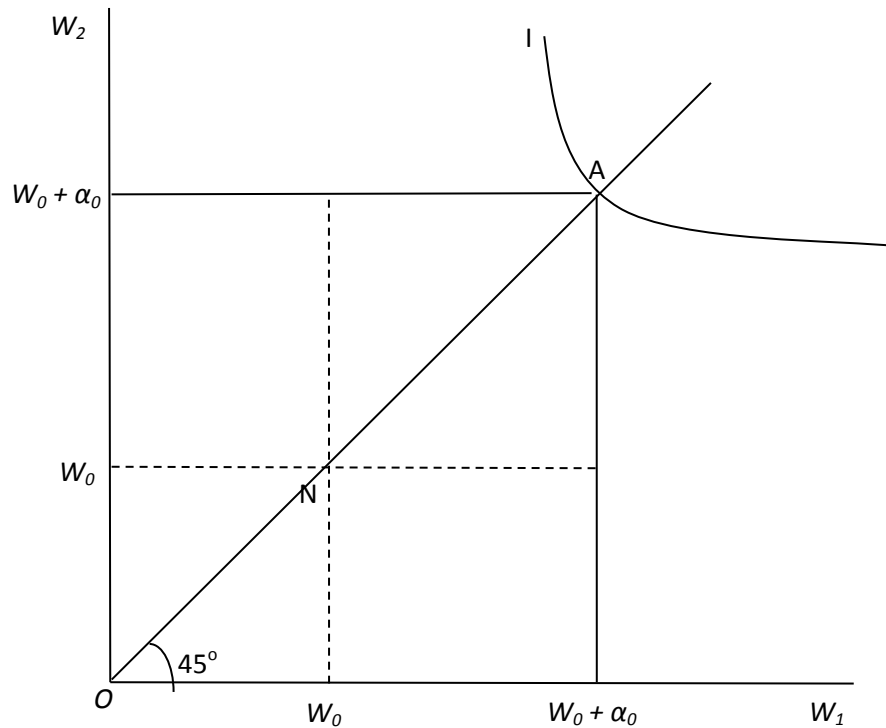
3.1 Bureaucrats' Corruption Behavior under Democracy

Now suppose an institutional arrangement, democracy emerges. We consider whether democratic elections can reduce the amount of corruption significantly. The mechanisms of democracy over corruption are as follows:

(1) Electoral Accountability. Identical voters elect government officials. When voters have a signal of a bureaucrat misusing public office for private benefits, no matter what's the amount of corruption, he will lose his job. Since there is no judicial intervention so far, the most severe and only punishment for him is always to be fired. Assume his wage income in office at the time period t_1 is W_1; the probability of winning the election again at the end of t_1 is π. So the expected total income after t_1 is $\pi \times W_t$ if he wins the election. If he loses the election, he could find another position in the job market and the expected income in the new position will be $\delta \times \pi \times W_t$, where δ is a discount number

and $\delta \in [0, 1]$. Now his expected wage income in t_1 is $W_1 + \pi \times W_t$ without corruption. With corruption his income in the two states "no punishment" and "punishment" is:

$$(W_1 + \pi \times W_t + \alpha, \ W_1 + \delta \times \pi \times W_t + \alpha) = (W_1 + \pi \times W_t + \alpha, \ W_1 + \pi \times W_t + \alpha - (1 - \delta) \times \pi \times W_t)$$

Suppose δ, π, W_t are all exogenous variables and they are uncorrelated with α. Let

$$W_0 = W_1 + \pi \times W_t, \ and \ \alpha_d = (1 - \delta) \times \pi \times W_t.$$ The bureaucrat corruption choices can be

described as $(W_0 + \alpha, \ W_0 + \alpha - \alpha_d)$, where W_0 and α_d are both constants. Generally speaking, in modern societies, a government official's wage income is much less than the public resources under his control. That is, $\alpha_0 >> W_0 \geq \alpha_d$.

(2) Monitor System. Because of free press and political competition, the probability of his corruption behavior being detected in a democratic regime ($p_D = p_D(\alpha)$) is reasonably higher than that in an autocracy. $p_D(\alpha)$ can be understood as an information function, and $p'_D(\alpha) > 0$, $0 = p_D(0) \leq p_D(\alpha) \leq p_D(\alpha_0) = 1$. The nature of $p_D(\alpha)$ is that although there is information asymmetry between voters and bureaucrats, voters can get incomplete information through free press and party competition. When the bureaucrat is doing corruption, the information will accumulate as α increases, so $p'_D(\alpha) > 0$. In addition, as $\Delta \alpha$ increases, I assume Δp will be larger, so $p''(\alpha) \geq 0$. The notion of this assumption is that when a monitoring system finds his corruption behavior, it not only has the information for his current performance, but will actively collect more information about his previous behavior to find out whether he did corruption before.

Now the bureaucrat's preferences for corruption can be described by the following function:

$$\begin{cases} Max\, V(p_D, \alpha) = (1 - p_D(\alpha)) \times U(W_0 + \alpha) + p_D(\alpha) \times U(W_0 + \alpha - \alpha_d) \\ S.t. \ \ (1 - p_D(\alpha)) \times (W_0 + \alpha) + p_D(\alpha) \times (W_0 + \alpha - \alpha_d) \geq W_0 \end{cases}$$

$$\Leftrightarrow \begin{cases} Max\, V(p_D, \alpha) = (1 - p_D(\alpha)) \times U(W_0 + \alpha) + p_D(\alpha) \times U(W_0 + \alpha - \alpha_d) \\ S.t. \ \ \alpha - p_D(\alpha) \times \alpha_d \geq 0 \end{cases}$$

Notice the political implication of $p'_D(\alpha)$ is the marginal probability of being punished when the bureaucrat enjoys one more dollar corruption income, thus $p'_D(\alpha)$ is a very small number even though $p'_D(\alpha) > 0$ and $p''(\alpha) \geq 0$. From $\alpha - p(\alpha) \times \alpha_D \geq 0$ (see note ii for proof)[ii], his corruption behavior now is converted into a single purpose nonlinear programming problem and the optimal level of corruption is determined by the shape of $V(p_D, \alpha)$ and $\alpha - p_D(\alpha) \times \alpha_d$.

Define the bureaucrat's Arrow-Pratt coefficient of absolute risk aversion at α as $r_A(\alpha) = -u''(\alpha)/u'(\alpha)$. Given that the bureaucrat is not highly risk averse and the marginal probability $p'_D(\alpha)$ is a small number, specifically, when

$$p'(\alpha) < \frac{1}{\alpha_d} = (1 - \delta) \times \pi \times W_t \ and$$

$$r_A(\alpha) = -u''(\alpha)/u'(\alpha) \le \frac{p''(\alpha)}{2p'(\alpha)} + \frac{(1-p(\alpha))U''(W_0+\alpha) + p(\alpha)U''(W_0+\alpha-\alpha_d)}{2p'(\alpha)[U(W_0+\alpha-\alpha_d)-U(W_0+\alpha)]}$$

we can prove institutional constraint $\alpha - p_D(\alpha) \times \alpha_d$ is a monotone increasing function of α and $V'(p, W_1, W_2) > 0$ in $[0, \alpha_0]$ (see Note iii for proof)[iii], which implies as the marginal budget keeps going up, a bureaucrat will always enjoy every dollar from the corruption income. Therefore there is no Interior Solutions but a Corner Solution $\alpha = \alpha_0$ (the equilibrium E_d in Figure 2) for the bureaucrat under a democracy constraint and

$$V_{D-Max}(\alpha) = (1 - p_D(\alpha_0)) \times U(W_0+\alpha_0) + p_D(\alpha_0) \times U(W_0+\alpha-\alpha_d) = U(W_0+\alpha_0-\alpha_D)$$

Figure 2
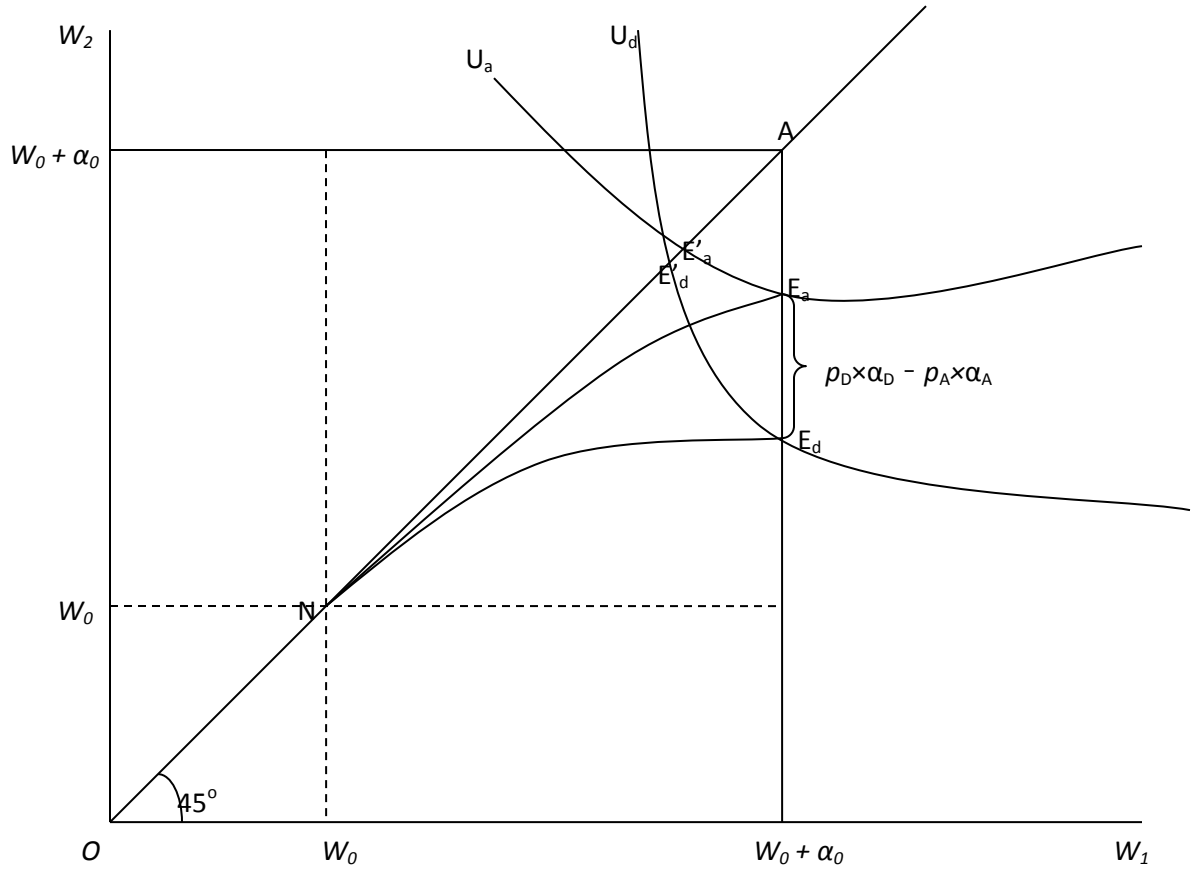
Similarly, if we assume in an autocracy, the corresponding punishment and the probability of being punished is relatively smaller, we can see that the bureaucrat still fixes his level of corruption at α_0.

$$V_{A-Max}(\alpha) = (1 - p_A(\alpha_0)) \times U(W_1) + p_A(\alpha_0) \times U(W_2)$$

$$= U(W_0+\alpha_0-\alpha_A)$$

$$V_{A-Max}(\alpha) - V_{D-Max}(\alpha) = U(W_0+\alpha_0-\alpha_A) - U(W_0+\alpha_0-\alpha_D) > 0$$

The bureaucrat in a democracy has to pay much more cost (the expected punishment), thus his expected utility might be smaller than his counterparts in an autocracy. Since

$\dfrac{p_D(\alpha)}{1-p_D(\alpha)} > \dfrac{p_A(\alpha)}{1-p_A(\alpha)}$, his indifference curve looks steeper in a democracy and people become a little more risk-averse. But the actual level of corruption does not change from an autocracy to a democracy.

In Figure 2, we can see the different institutional arrangements change the bureaucrat's budget line in different ways. Now the bureaucrat is trying to maximize his utility under a new budget line NE_d or NE_a rather than NA. However, any institutional arrangement which can decrease the level of corruption significantly has to increase the expected punishment (corruption cost) at least beyond the bureaucrat's expected corruption benefit at the low level of corruption. In other words, the new budget line has to be below the horizontal line W_0N since a certain low level of corruption. Theoretically, any corner solutions except N cannot reduce corruption, so a good institutional design should lead us to find the possible interior solutions and the actual levels of corruption in different countries are determined by the potential interior solution and thus the proposed institution.

Basically we have two approaches to threaten the bureaucrat's corruption behavior. This first one is to increase the punishment α_d. But as α_d is a constant and exogenous variable, without a new institution intervention, electoral accountability has little influence to α. Even a democracy could raise the penalty, this potential punishment is hard to be equivalent to the one that judicial system can offer. On the other hand, we may also strengthen the monitoring capability and inspect every dollar government expended, as some other scholars have argued, free press and party competition is important to limit the scope of corruption. But the embarrassment is that monitoring bureaucrats' behavior is just a prerequisite or necessary condition of penalty. When democratic punishment cannot threaten bureaucrats' vital interests, how can we expect to see a sufficient better outcome emerging? That's why I will focus on the role of judicial independence in the following section.

3.2 Fighting Corruption: The Role of Judicial Independence

In political science literature, judicial independence usually refers to the autonomy of judges, which implies the members of the judiciary ought to have an independent relationship with other parts of the political system and they can expect their decisions to be implemented free from any outside pressure (Russell, 2001). The mathematical form of judicial independence can be expressed as follows in the sense of fighting bureaucratic corruption.

Suppose α represents the mount of public resources which have been corrupted, and $L(\alpha)$ is a punishment for his behavior defined by law. $L(\alpha)+\varepsilon$ is the real punishment made by judges, where ε is a random error. Then judicial independence refers to:

$$E(L(\alpha)+\varepsilon) = E(L(\alpha)) + E(\varepsilon) = E(L(\alpha)) = L(\alpha)$$

Because a normal form of government intervention in judicial system is to decrease punishment, we can introduce $G(\alpha)<0$ as a measure of judicial dependence. When judges' decision is influenced by the government, the expected punishment for a bureaucrat will be:

$$E(L(\alpha)+G(\alpha)+\varepsilon) = E(L(\alpha)) + E(G(\alpha)) + E(\varepsilon) = L(\alpha)+G(\alpha) < L(\alpha)$$

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Basically, we can use the similar logic to analysis the role of judicial independence, and the bureaucrat's strategy is still to select the perfect level of corruption under punishment constraints. But there are two differences between democratic constraint and judicial constraint. The first one is the promising punishment is not a constant in the judicial system. The more the public resources corrupted, the more severe punishment will be given to him. So α_J is a monotone increasing function of α. Because the independent judicial system can enforce a strict sanction on government officials, we define the sanction function $\alpha_J = J(\alpha) > \alpha$ for any $\alpha \in [0, \alpha_0]$ and $J(0) = 0$ (no corruption, no punishment), $J'(\alpha) > 0$. In addition, once all the public resources are corrupted, the bureaucrat will receive a more severe punishment, $J(\alpha_0) - (W_0 + \alpha_0) > 0$. To simplify our analysis, let $J''(\alpha) = 0$, which implies the anti-corruption law will not increase the marginal punishment to the bureaucrat suddenly because he received one more dollar illegal income. The second difference is that courts have to have substantial evidences to prove he misused public resources for personal benefits, so the probability of being monitored, and hence the probability of being punished will be much smaller in the judicial system, but we still have $p_J'(\alpha) > 0$.

Now the bureaucrat's preferences for corruption under judicial constraint can be described by the following function:

$$\begin{cases} Max\,V(p_J(\alpha), \alpha) = (1 - p_J(\alpha)) \times U(W_0 + \alpha) + p_J(\alpha) \times U(W_0 + \alpha - J(\alpha)) \\ S.t.\quad (1 - p_J(\alpha)) \times (W_0 + \alpha) + p_J(\alpha) \times (W_0 + \alpha - J(\alpha)) \geq 0 \end{cases}$$

$$\Leftrightarrow \begin{cases} Max\,V(p_J(\alpha), \alpha) = (1 - p_J(\alpha)) \times U(W_0 + \alpha) + p_J(\alpha) \times U(W_0 + \alpha - J(\alpha)) \\ S.t.\quad W_0 + \alpha - p_J(\alpha) \times J(\alpha) \geq 0 \end{cases}$$

So his optimal corruption behavior is also converted into a single purpose nonlinear programming problem, and there is one and only one interior solution $\alpha^{**} \in (0, \alpha_0)$ (see Note iv for proof)[iv].

Now suppose the levels of judicial independence are different in two countries A and B. We can substitute $J_A(\alpha) = L_A(\alpha) + G_A(\alpha)$ and $J_B(\alpha) = L_B(\alpha) + G_B(\alpha)$. Other things being equal, if $J_B(\alpha) \leq J_A(\alpha)$ then we predict the bureaucratic corruption will be more pervasive in country B than in country A. That is, $\alpha_B^{**} > \alpha_A^{**}$.

Figure 3 gives us some intuitionistic notions of why an independent judicial system can reduce the level of corruption efficiently and determine the different levels of corruption across countries. In figure 3, compared to the democratic constraint, there is an inflection point in the judicial budget line because the strictest punishment is always enforced by judicial system, so even when the probability of being punished is relatively small, the bureaucrat is facing a high cost of corruption behavior. To see this, let's compare the features of different budget lines:

In a democracy:

$$\frac{\partial (\alpha - p_D(\alpha) \times \alpha_d)}{\partial \alpha} > 0 \text{ and } \frac{\partial^2 (\alpha - p_D(\alpha) \times \alpha d)}{\partial \alpha^2} < 0$$
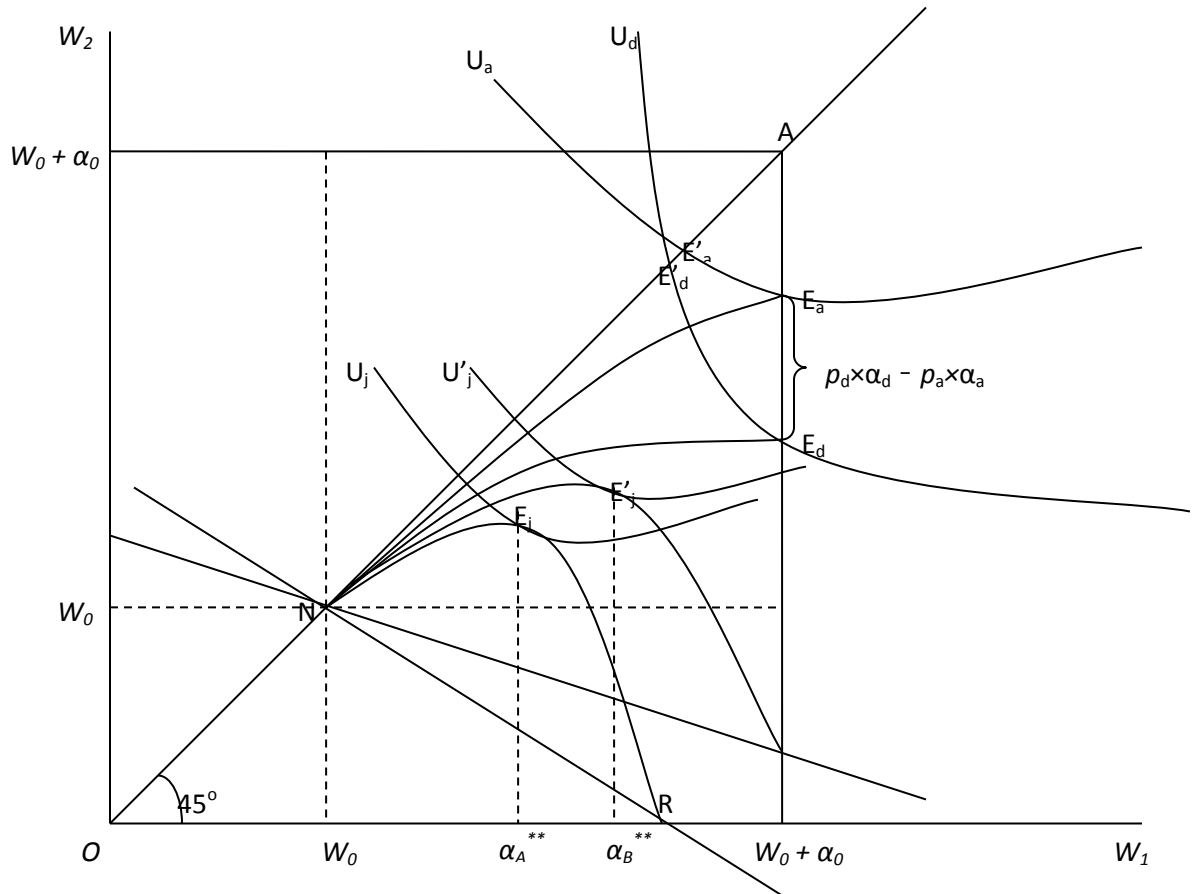
In a judicial constraint,

$$\frac{\partial^2(\alpha - p_J(\alpha) \times J(\alpha))}{\partial \alpha^2} < 0 \text{ but}$$

$$\frac{\partial(\alpha - p_J(\alpha) \times J(\alpha))}{\partial \alpha} > 0 \text{ when } \alpha \text{ is small and}$$

$$\frac{\partial(\alpha - p_J(\alpha) \times J(\alpha))}{\partial \alpha} < 0 \text{ when } \alpha \text{ is very large}$$

Figure 3

Basically, the shape of judicial constraint line is influenced by two factors, the monitoring technology and the level of judicial independence. So my findings provide a new support for the arguments that the monitoring technology matters to the level of corruption. The joint effect of the monitoring technology and judicial independence determines the equilibrium when economic variables are held as constants. Under certain monitoring technology, an efficient way to influence the bureaucrat's behavior is to change the punishment. Let $J(\varepsilon) = +\infty$ for any $\varepsilon > 0$. That is, any corruption behavior once monitored will be enforced a horrible penalty. $W_0 + \varepsilon - p_J(\varepsilon) \times J(\varepsilon) \to -\infty$, so the rational bureaucrat won't do any corruption. Graphically, this budget line will be the

vertical line NW_0. In this case, the equilibrium will be $N(W_0, W_0)$, which implies there is no corruption.

In most countries, even with $J_i(\alpha) = L_i(\alpha) + G_i(\alpha) < L_i(\alpha)$, as long as there is an inflection point in the judicial budget line, the different levels of corruption will be predicted by the levels of judicial independence.

Section Four: Empirical Analyses

A Simple Model of Corruption

In previous analyses, I do not consider the effects of economic variables on the amount of corruption. However, both the wage income W_0 and the amount of public resources under bureaucrats control (α_0) can influence the actual level of corruption. Therefore, corruption can be identified as a product in a certain society with specific economic and political structures. Suppose E and P respectively represent the amount of economic and political resources controlled by government bureaucrats. Symbol "A" refers to an overall measure of the institutional environment, or to what extent bureaucrats may easily make use of public responsibility for private ends. I assume the aggregate level of bureaucratic corruption can be described by the following Cobb-Douglas production function:

$$Corruption = A \times E^\alpha \times P^\beta$$

Where α denotes the index that bureaucrats use public economic resource for personal purposes or interests. E^α thus refers to how much public resources have been corrupted due to economic conditions. Similarly, β denotes the index that bureaucrats use public political resources for personal purposes or interests. P^β thus refers to how much public political resource has been corrupted under certain political environment.

From

$$Corruption = A \times E^\alpha \times P^\beta$$

$$\log(Corruption) = \log(A) + \alpha \times \log(E) + \beta \times \log(P)$$

Because bureaucrats always have motivations to convert the public resources into private ends, α > 0 and β > 0, I expect to see the level of corruption is positively associated with the economic and political resources under the government's control.

A Brief Review of Literature on Judicial Independence (JI)

It is well recognized that the rule of law is the cornerstone of a prosperous society. Among various aspects of law, JI is considered to be a foundation for the rule of law (United Nations, 1985). Most political scientists believe that the separation of powers and checks and balances is essential for a regime to be well-functioning. As one of the most effective checks and balances, the independence of the judiciary can prevent the abuse of government power by other political branches.

The literature has not reached the consensus on the definition of JI. Some scholars have produced long lists of criteria the judiciary must meet, whereas others focus on

more narrow aspects of judicial institutions (Landes and Posner 1975; Shetreet 1985; Larkins 1996). According to the number of characteristics involved, JI can be defined in the following ways.

The first type of definition deals with two levels of characteristics: judge and judiciary level (Abbasi, 2008). The independence of judge refers to the impartiality of judicial decision. That is, the results of a court should not be intervened by the judge's personal interest in the outcome of the case. On the contrary, the independence of judiciary, autonomy, is defined from the institutional perspective. It refers to the relationship between the judiciary and political branches. In other words, specific arrangements are created to prevent the political forces from becoming the main determinants of judicial behavior. In literature, the independence of judge is synonymous to decisional independence, whereas the independence of judiciary is identical to institutional independence.

The second type of definition includes three characteristics. According to the World Bank, the judicial independence includes three dimensions: impartiality, compliance with the judicial decisions, and free from interference from other political branches. Impartiality refers to the situation in which the results of a court are not influenced by the judge's personal interest. The compliance with the judicial decisions implies that judicial decisions should be well respected once they are rendered. Insulating judges from interference of government officials is often taken to be the most important aspect of judicial independence. Similar definition is also provided by Greene (2006). Based on interviews of Canadian appellate court judges, Greene (2006) also identified three aspects of judicial independence: impartiality, no interference from other judges, and complete freedom to decide.

Another innovative definition is put forward by Rios-Figueroa. He (2005) proposed to unpack the concept of JI into four components: autonomy, external independence, internal independence, and the institutional location of the public prosecutor's office. Autonomy refers to the relation between the judiciary and the elected branches of government. External independence refers to the relation between Supreme Court judges and government branches, whereas internal independence is the relation between lower court and supreme. As for the institutional location of the public prosecutor's office, the author sets three categories: within the judiciary, the executive, or as an autonomous organ. If judges and prosecutors belong to the same judiciary, they would be more independent of political powers from other government organs.

In my analysis, I adopt the definition that JI has two characteristics: decisional independence and institutional independence. In line with these two dimensions of JI, I am motivated to find two sources of exogenous variations in political institution to instrument JI. The first instrument—tenure of Supreme Court judges, indicates the decisional independence, whereas the second instrument—the year of the constitution significantly revised last time, represents the institutional independence.

Research Design
A lot of research has been conducted empirically to uncover the causal effect of specific political institutions on corruption. My interest in this paper is to identify the causal effect of judicial system on the outcome of corruption. However, cross-country analysis often faces an obstacle, the endogeneity problem if I simply employ an OLS

regression. First, it is confronted by the simultaneity problem. There are unobservable variables that may determine both the decision to form the judicial system and the level of corruption. The second issue is concerned with reverse causality: a change in corruption level may lead to a change in the decision to outline the judicial structure. It is quite likely that high-income economies with low level of corruption can afford better judicial system. These endogeneity problems put threat to internal validity of my study, and become the biggest concern for the research design of my study.

A well-known strategy to resolve the endogeneity issue is to use instrumental variables (IV). The two IVs used in my analysis are the year of the constitution significantly revised last time, and tenure of Supreme Court judge. For abbreviation, the first IV is called YCR, and the second IV is called tenure. The logic is that YCR does not affect the corruption level of countries directly, but countries whose constitution were significantly revised more recently tend to have less stable judiciary system and less rigidity of constitution. The volatile judiciary system indicates a weak judicial independence. Similarly, tenure of judges does not influence the bureaucrats' corruptive behavior directly, but longer terms for judges provide greater job security so that judges' concerns about holding their position or being promoted do not influence their decisions, which may further lead to the independence of judiciary.

Specifically, the IV approach will proceed in two steps: in the first step, the judicial independence variable is regressed on YCR, tenure and other observable exogenous regressors; in the second step, the predicted value of the judicial variable is used in the corruption regression. The validity of IV will be discussed in detail in the following sections.

Data and Descriptive Statistics

Table 1 provides descriptive statistics for the key variable of interest. The Corruption Perceptions Index in 2006 is my measure of corruption outcome, ranging from 1.8, the most corrupt country Haiti, to 9.6, the cleanest country New Zealand. My key explanatory variable is the level of judicial independence in 2005, with a range of 0.3 to 9.2, 0.3 corresponding to the least judicial independent country Venezuela and 9.2 referring to the most judicial independent country Germany. The IV variables-YCR spans almost two centuries, varying from 1814 to 2005; and Tenure ranges from 0 to 2, with 0 representing a tenure less than six years, 1 indicating a tenure more than six years but not life long, and 2 representing life long. Since CPI 2006 actually refers to the corruption level in the year of 2005 in different countries, all the independent variables in my empirical study are measured in 2005.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CPI 2006	162	4.100617	2.155867	1.8	9.6
Log(GDP)	165	8.584104	1.18453	6.39693	10.9836
Government Size	136	6.054412	1.306103	2.4	9.3
Government Consumption	138	5.976087	2.047272	0	10
Government Investment	129	5.209302	3.358	0	10
Judicial Independence	119	4.880672	2.338052	.3	9.2
Political Rights	164	3.457317	2.148906	1	7
Civil Liberty	164	3.256098	1.801914	1	7
YCR	165	1992.921	21.59804	1814	2005
Tenure	130	1.407692	.7334336	0	2

Figure 4: Reduced-Form Relationship
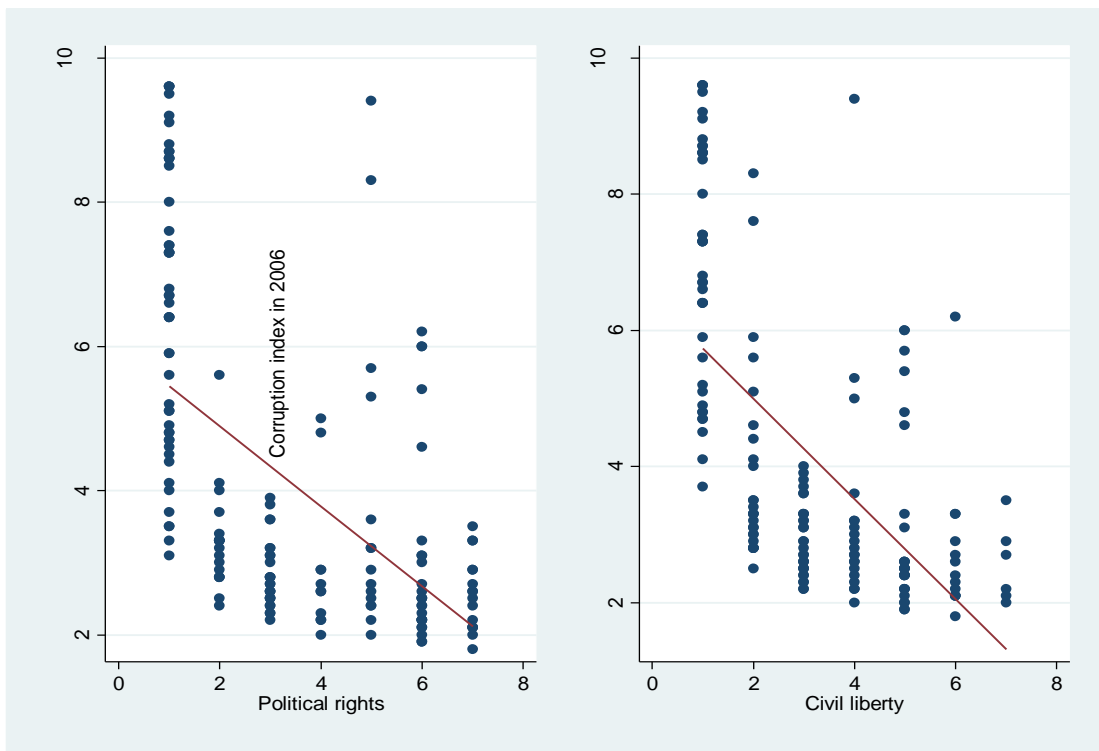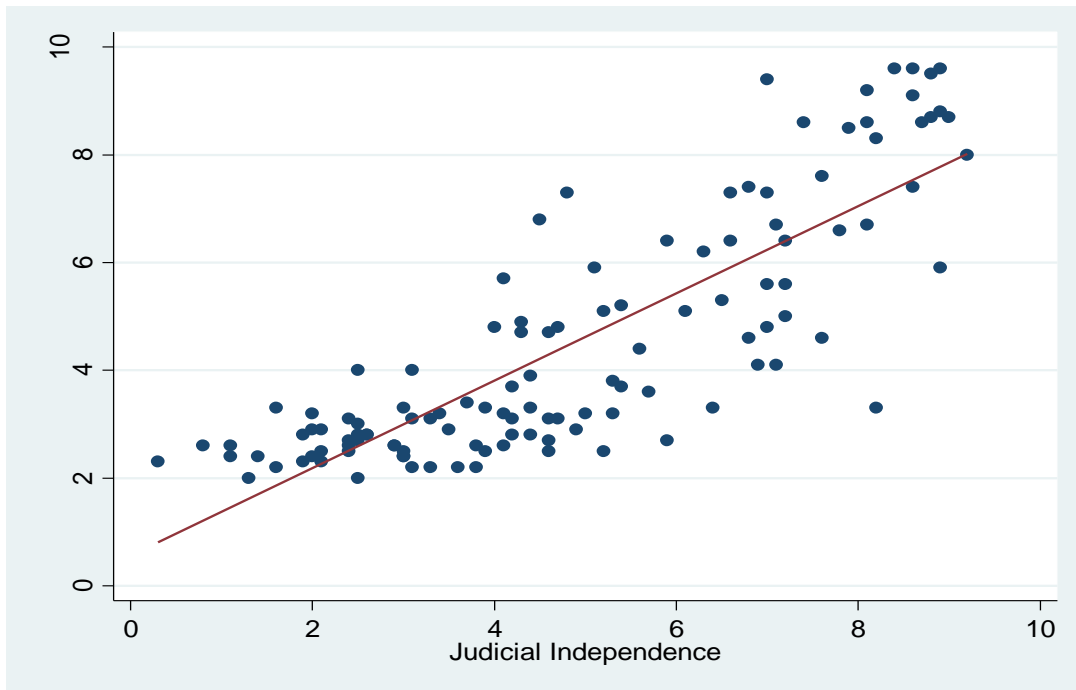Between Corruption Index and Democracy (Political Rights or Civil Liberty)

Figure 5: Reduced-Form Relationship
Between Corruption Index and Judicial Independence

Which institution is more effective in fighting corruption: democracy or judicial independence? Figure 4 and Figure 5 presents a simple graphic illustration of the relative efficiency of these two institutions. Figure 4 plots the corruption index in 2006 against two measures of democracy: political rights and civil liberty. It shows a very weak association between corruption and democracy regardless of which measure of democracy is applied. In sharp contrast, Figure 5 presents a strong positive association between corruption and judicial independence. Countries with higher level of judicial independence present a lower level of corruption. Naturally, I conclude that democracy has a weaker impact on reducing corruption, while judicial independence has a stronger impact on it. The next section will provide regression results to substantiate this statement.

Figure 6: Reduced-Form Relationship
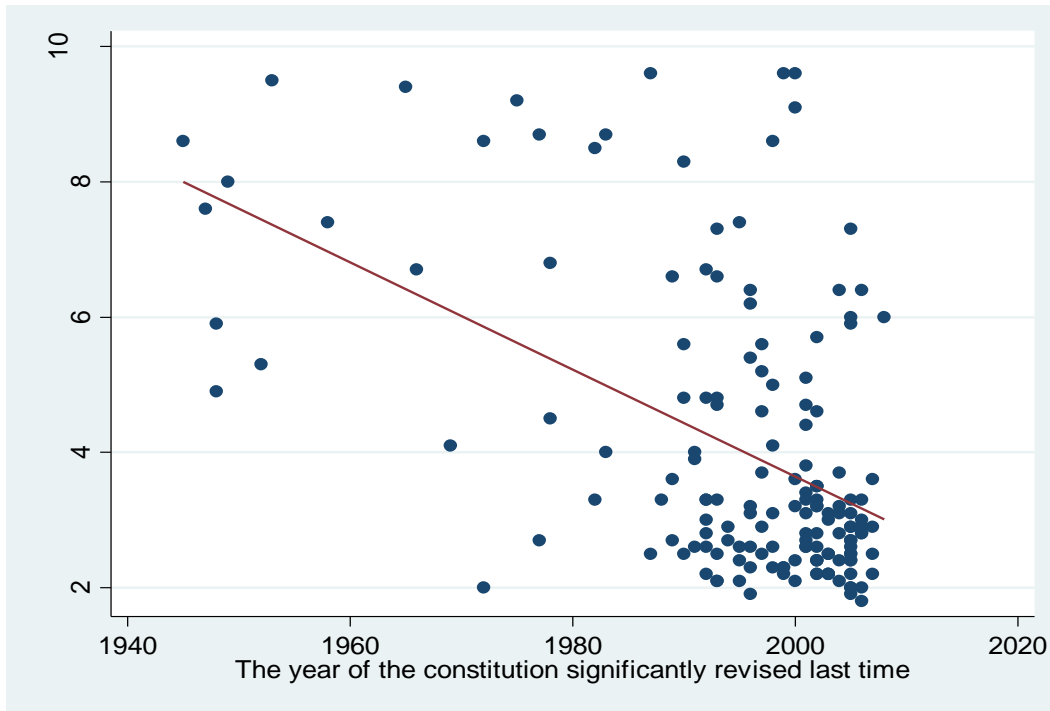Between Corruption Index and YCR (IV)

Figure 6 plots the CPI 2006 against the year when the current constitution was significantly revised last time for a sample of 165 countries (two countries with YCR in the 1800s are dropped out of the graph). It shows a strong negative relationship between these two variables. Countries which revised their constitution more recently are substantially more corrupt than countries which revised current constitution many years ago. To validate this, I will regress current corruption level (in 2006) on current judicial independence level (in 2005), and instrument the latter by YCR and *tenure* variables. The IV regression result will be presented in the following sections.

Ordinary Least-Squares Regressions

In this part, I will present the naive result from OLS regression in Table 2. The basic specification is listed as follows:

$$Corruption_i = \mu + \alpha \times Judicial\_Independence_i + X_i{'}\beta + \varepsilon_i \quad (1)$$

Where $Corruption_i$ is the dependent variable, indicating the corruption level in 2006 for country i; $Judicial\_Independence_i$ is my key explanatory variable, indicative of the judicial independence level of country i in 2005. I use the lagged values instead of current values of $Judicial\_Independence$ to capture the causal effect. X_i is a vector of other covariates, including logarithm of GDP, government size, government consumption, government investment, political rights, and civil liberty; and ε_i is a random error term. The coefficient of interest throughout the paper is α, the effect of judicial independence on the level of corruption. Table 2 reports the OLS regression estimates of corruption on democracy, judicial independence, and other controls.

First, the effect of democracy on controlling corruption is not effective. Political rights variable has insignificant effect against corruption no matter whether the level of

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judiciary independence is controlled (see Model 2 and Model 4). Yet civil liberty, another measure of democracy, is statistically significant in Model 2, which excludes judiciary level.

Second, the coefficient of judicial independence variable, an estimate of 0.464, shows its strong positive association with the dependent variable CPI 2006. Further, once the judiciary level is controlled, two measures of democracy become insignificant. The overall OLS results indicate the correct predication of my formal model. Compared to democracy index, judicial independence can explain the differences of corruption across countries much better.

Table 2: OLS Regression Analyses
(Dependent variable: CPI 2006)

Independent Variables	Model 1	Model 2	Model 3	Model 4
Log(GDP)	1.250***	1.118***	0.842***	0.794***
Government Size	-0.203	-0.114	-0.155	-0.121
Government Consumption	-0.072	-0.112	-0.005	-0.023
Government Investment	0.148*	0.102	0.102*	0.087
Judicial Independence			0.475***	**0.464***
Political Rights		0.228		0.102
Civil Liberty		-0.445*		-0.194
Adj R^2	0.7067	0.7153	0.8243	0.8229
Significant level: *** p<0.001, ** p<0.01, * p<0.05				

Judicial Independence and Corruption: IV results

As I discussed in the *Research Design* section, the endogeneity problems will bias the OLS result and make the OLS estimates inconsistent. Therefore, in order to estimate the impact of political institution on corruption level, I need find a source of exogenous variation in political institution, an instrumental variable (IV), to remove the spurious correlation between the explanatory variable and unobserved characteristics. The two instruments I am using are YCR, the year of a country's constitution significantly revised last time, and *tenure*, term of judges. Conceptually, the IV approach imply that, in the first stage, a variable which is unrelated to the outcome variable is used as a predictor of the key explanatory variable; in the second stage, the outcome variable is regressed on the predicted measure from the first stage.

But, the validity of inferences from an IV analysis depends on the appropriateness of the exclusion restriction assumption, which imply that, conditional on the controls included in the regression, YCR and *tenure* have no effect on corruption level today (in

2006), other than their effect through the institutional development of judicial independence.

The two-stage least-squares estimates are presented in Table 3. $JudicialIndependence_i$ is treated as endogenous and modeled as following:

$$JudicialIndependence_i = \varsigma + \theta_1 * YCR_i + \theta_2 * Tenure_i + X_i' \pi + v_i \ (2)$$

Where YCR_i is the year when a country's constitution was significantly revised last time, and $Tenure_i$ is the tenure of Supreme Court judges. The exclusion restriction is that these two variables do not appear in equation (1)

Table 3: IV (2SLS) Regression of Corruption
(Dependent variable: CPI 2006)
(Instrumented: Judicial Independence 2005)
(IV: YCR and *tenure*)

Independent Variables	Model 1	Model 2	Model 3	Model 4
Log(GDP)		.579*	.393**	.553**
Government Size		-.121		-.111
Government Consumption		.094		.085
Government Investment		.051		.049
Judicial Independence	1.103***	.849**	.919***	**.853****
Political Rights	.078		.099	.110
Civil Liberty	-.152		-.134	-.136
Adj R^2	0.6104	0.7588	0.7225	0.7523
Significant level: *** p<0.001, ** p<0.01, * p<0.05				

The corresponding 2SLS estimate of the impact of judicial independence on corruption in model 4 is 0.853 (standard error = 0.328), which is larger than the OLS estimate 0.464 reported in Table 2 (model 4). This suggests the downward bias of OLS estimates. In addition, the existence of attenuation bias, and the measurement error in the judicial independence variable is likely to be more important than reverse causality and omitted variable biases. It is plausible that one single measure of political institution can hardly capture the whole set of political institutions that matter for corruption level. The IV approach presents us a more credible estimate.

I perform two types of tests to consolidate my IV results. First, I test the null hypothesis of exogeneity of judiciary independence variable. If this null is not rejected, the analysis will proceed under the assumption of exogeneity and run OLS regressions. Otherwise, the analysis will proceed to do IV. Typically, Hausman test will accomplish this task. Second, the over-identification test is performed. Since I have only one

potential endogenous variable but have two candidate instruments, I need test the exogeneity of the extra instruments. That is, whether all of the instruments are valid.

The Hausman test presents a chi-square value of 9.63 with a P-value of 0.0012, indicating rejection of the consistency of OLS and support for using IV regression. The over-identification test has a P-value of 0.895, which is highly insignificant. So at the typical 5% significance level, I would fail to reject the hypothesis that the instrumental variables are all exogenous. These two instruments turn out to be valid for my analysis.

Discussion and Conclusion

It is widely discussed that differences in institutions are at the root of large differences in economic outcome across countries. However, plagued with endogeneity problems, it is difficult to isolate exogenous sources of variation in institutions to estimate their effect on economic performance. Employing a simple formal model as micro foundation, this paper particularly focuses on the causal effect of judicial independence status on the corruption level. Two instrumental variables: the year when a country's current constitution was significantly revised last time, and tenure of judges, serve as a source of exogenous differences in judicial independence level. However, these two IVs do not directly influence corruption level. Thus, the exclusion restriction assumption is met. The estimates are robust across various specifications. My findings indicate that a severe punishment enforced by independent judicial system is necessary to deter bureaucrats' corruption behavior, and different levels of corruption across countries can be explained much better than democracy does.

There are many questions left unanswered in my paper. In the formal model, I assume government officials are identical in all aspects and they are risk-averse. In reality, different bureaucrats in similar positions may present different attitudes towards the potential sanction of risk. In addition, I do not consider how informal institutions such as culture and customs influence bureaucrats' corruption behavior in the formal model and empirical analyses. These questions leave room for the future study.

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Appendix:

$$p(\text{punishment}) = p(\text{punishment} \cap \text{monitored}) + p(\text{punishment} \cap \text{Not monitored})$$
$$= p(\text{punishment/monitored}) \times p(\text{monitored}) +$$
$$p(\text{punishment/Not monitored}) \times p(\text{Not monitored})$$
$$= 1 \times p(\text{monitored}) + 0$$
$$= p(\text{monitored})$$

Let $g(\alpha) = \alpha - p_D(\alpha) \times \alpha_d$

$$g(0) = 0; g(\alpha_0) = \alpha_0 - \alpha_d > 0$$
$$g'(\alpha) = 1 - p_D'(\alpha) \times \alpha_d$$
$$g'(0^+) = 0$$
$$g''(\alpha) < 0$$
$$\Rightarrow g(\alpha) = \alpha - p_D(\alpha) \times \alpha_d > 0$$

(1) From ii $g'(\alpha) = 1 - p_D'(\alpha) \times \alpha_d$, if $p'(\alpha) < \dfrac{1}{\alpha_d} = (1-\delta) \times \pi \times W_t$, then institutional

constraint $g(\alpha) = \alpha - p_D(\alpha) \times \alpha_d$ is a monotone increasing function of α.

(2) From $V(p_D, \alpha) = (1 - p_D(\alpha)) \times U(W_0 + \alpha) + p_D(\alpha) \times U(W_0 + \alpha - \alpha_d)$,

$$\frac{\partial V}{\partial \alpha} = -p_D'(\alpha) \times U(W_0 + \alpha) + (1 - p_D(\alpha)) \times U'(W_0 + \alpha) + p_D'(\alpha) \times U(W_0 + \alpha - \alpha_d)$$
$$+ p_D(\alpha) \times U'(W_0 + \alpha - \alpha_d)$$

$$\frac{\partial V}{\partial \alpha}\bigg|_{\alpha = \alpha_{0-}} = -p_D'(\alpha_{0-}) \times U(W_0 + \alpha_0) + p_D'(\alpha_{0-}) \times U(W_0 + \alpha_0 - \alpha_d) + U'(W_0 + \alpha_0 - \alpha_d)$$

$$\geq (1 - p_D'(\alpha_{0-})) \times U(W_0 + \alpha_0 - \alpha_d) \geq 0$$

$$\frac{\partial^2 V}{\partial \alpha^2} = -p_D''(\alpha) \times U(W_0 + \alpha) - p_D'(\alpha) \times U'(W_0 + \alpha) + U''(W_0 + \alpha) - p_D'(\alpha)) \times U'(W_0 + \alpha)$$
$$- p_D'(\alpha) \times U''(W_0 + \alpha) + p_D''(\alpha) \times U(W_0 + \alpha - \alpha_d) + p_D'(\alpha) \times U'(W_0 + \alpha - \alpha_d)$$
$$+ p_D'(\alpha) \times U'(W_0 + \alpha - \alpha_d) + p_D(\alpha) \times U''(W_0 + \alpha - \alpha_d)$$
$$= 2p_D''(\alpha) \times [U'(W_0 + \alpha - \alpha_d) - U'(W_0 + \alpha)] + p_D''(\alpha) \times [U(W_0 + \alpha - \alpha_d) - U(W_0 + \alpha)]$$
$$+ (1 - p_D(\alpha)) \times U''(W_0 + \alpha) + p_D(\alpha) \times U''(W_0 + \alpha - \alpha_d)$$

Therefore, when

$$r_A(\alpha) = -u''(\alpha)/u'(\alpha) \leq \frac{p''(\alpha)}{2p'(\alpha)} + \frac{(1 - p(\alpha))U''(W_0 + \alpha) + p(\alpha)U''(W_0 + \alpha - \alpha_d)}{2p'(\alpha)[U(W_0 + \alpha - \alpha_d) - U(W_0 + \alpha)]}$$

We have $\dfrac{\partial^2 V}{\partial \alpha^2} < 0$ and $\dfrac{\partial V}{\partial \alpha}\bigg|_{\min} = \dfrac{\partial V}{\partial \alpha}\bigg|_{\alpha = \alpha_{0-}} \geq 0$, which implies there is no Interior

Solutions but a Corner Solution $\alpha = \alpha_0$.

From

$$\begin{cases} Max\, V(p_J(\alpha), \alpha) = (1-p_J(\alpha)) \times U(W_0 + \alpha) + p_J(\alpha) \times U(W_0 + \alpha - J(\alpha)) \\ S.t.\ W_0 + \alpha - p_J(\alpha) \times J(\alpha) \geq 0 \end{cases}$$

$$\frac{\partial V}{\partial \alpha} = -p_J{}'(\alpha) \times U(W_0 + \alpha) + (1 - p_J(\alpha)) \times U'(W_0 + \alpha) + p_J{}'(\alpha) \times U(W_0 + \alpha - J(\alpha))$$
$$+ p_J(\alpha) \times (1 - J'(\alpha)) \times U'(W_0 + \alpha - J(\alpha))$$

$$V'(0^+) = U'(W_0) > 0$$

$$\frac{\partial^2 V}{\partial \alpha^2} = -p''(\alpha) \times U(W_0 + \alpha) - p'(\alpha) \times U'(W_0 + \alpha) - p'(\alpha) \times U'(W_0 + \alpha) + (1 - p(\alpha)) \times U''(W_0 + \alpha)$$
$$+ p''(\alpha) \times U(W_0 + \alpha - J(\alpha)) + p'(\alpha) \times (1 - J'(\alpha)) \times U'(W_0 + \alpha - J(\alpha))$$
$$+ (p'(\alpha) - p'(\alpha) \times J'(\alpha) - p(\alpha) \times J''(\alpha)) \times U'(W_0 + \alpha - J(\alpha))$$
$$+ p(\alpha) \times (1 - J'(\alpha))^2 \times U''(W_0 + \alpha - J(\alpha))$$
$$= -p''(\alpha) \times (U(W_0 + \alpha) - U(W_0 + \alpha - J(\alpha))) - 2p'(\alpha) \times U'(W_0 + \alpha)$$
$$+ (1 - p(\alpha)) \times U''(W_0 + \alpha) + p'(\alpha) \times (1 - J'(\alpha)) \times U'(W_0 + \alpha - J(\alpha))$$
$$+ (p'(\alpha) - p'(\alpha) \times J'(\alpha) - p(\alpha) \times J''(\alpha)) \times U'(W_0 + \alpha - J(\alpha))$$
$$+ p(\alpha) \times (1 - J'(\alpha))^2 \times U''(W_0 + \alpha - J(\alpha))$$
$$< 0$$

Let $g(\alpha) = W_0 + \alpha - J(\alpha)$

$$g(0) = W_0 > 0$$
$$g(\alpha_0) = W_0 + \alpha_0 - J(\alpha_0) < 0$$

So there exits at least one $\alpha^* \in (0, \alpha_0)$ to let $g(\alpha^*) = W_0 + \alpha^* - J(\alpha^*) = 0$.

$$g'(\alpha) = 1 - p'(\alpha) \times J(\alpha) - p(\alpha) \times J'(\alpha)$$
$$g'(0^+) = 0$$
$$g'(\alpha_0{}^-) = 1 - p'(\alpha_0{}^-) \times J(\alpha_0) - J'(\alpha_0{}^-) < 0$$
$$g''(\alpha) = -p''(\alpha) \times J(\alpha) - 2p'(\alpha) \times J'(\alpha) - p(\alpha) \times J''(\alpha) < 0$$

Therefore, So there exits only one $\alpha^* \in (0, \alpha_0)$ to let $g(\alpha^*) = W_0 + \alpha^* - J(\alpha^*) = 0$ and for

any $\alpha \in (0, \alpha^*)$, we have $W_0 + \alpha - P(\alpha)J(\alpha) > 0$, which means the bureaucrat might

have an interior solution to maximize his utility function.

Since

$$\frac{\partial V}{\partial \alpha}\Big|_{\alpha=\alpha^*} < 0$$

We must have one and only one $\alpha^{**} \in (0, \alpha^*)$ and $V'(\alpha^{**}) = 0$. At α^{**}, he can maximize his utility function.