ANALYSIS FOR THE RATIONALE OF THE ANTI-CORRUPTION RESERVING FUND SYSTEM

by

Qing (Jeanette) Dai
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Name:	**Qing Dai**
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Examining Committee:

Chair: **Ken Kasa**

Steeve Mongrain
Senior Supervisor

Gordon Myers
Supervisor

Phil Curry
Internal Examiner

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ABSTRACT

The anti-corruption reserving fund system is a recent arrangement in China against corruption. The paper makes payoff analysis of the anti-corruption reserving fund system from the perspectives of the civil servants and the cost analysis from the perspective of the government respectively, then points out the necessary and sufficient conditions for the existence of the system, furthermore, provides a simple dynamic case to illustrate a more realistic phenomenon in China under the anti-corruption reserving fund system. Finally, the paper draws some remarks and puts forward some suggestions to the anti-corruption reserving fund system in China.

Keywords: the anti-corruption reserving fund, payoff analysis, corruption, government servants.

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TABLE OF CONTENTS

Approval ii

Abstract iii

Acknowledgements iv

Table of Contents v

List of Figures vi

1 INTRODUCTION 1

1.1 Literature Review 1

2.2 The Anti-Corruption Reserving Fund System in Singapore 3

2.3 The Current Situation of Anti-Corruption Reserving Fund in China 4

2 THE ANALYSIS FOR THE RATIONALE OF THE ANTI-CORRUPTION RESERVING FUND SYSTEM 6

2.1 The Baseline Model 6

2.2 The Extended Model with the Anti-Corruption Reserving Fund System 14

2.2.1 Payoff Analysis of the Civil Servant with Anti-Corruption Reserving Fund System 14

2.2.2 Cost Analysis of the Government with the Anti-Corruption Reserving Fund System 14

2.2.3 The Necessary and Sufficient Condition for the Existence of the Anti-Corruption Reserving Fund System 23

2.3 A Simple Dynamic Case 28

3 CONCLUSION AND SUGGESTIONS 37

3.1 Conclusion 37

3.2 Related Policy Suggestions 40

Reference List 44

Appendix: 2006 Corruption Perceptions Index and Additional Background Data 45

LIST OF FIGURES

Figure 1 Supervision cost with/without sanction 13
Figure 2 The ways to prevent corruption at different supervision level 25
Figure 3 The total cost of anti-corruption reserving fund and optimal supervision level 27

1 INTRODUCTION

1.1 Literature Review

Corruption is a common and persistent problem. From economic perspective, it ordinarily refers to the use of public office for private gains, where an official (the agent) entrusted with carrying out a task by the public (the principal) engages in some sort of malfeasance for private enrichment which is difficult to monitor for the principal.[1]

The economic research in corruption can be dated back to Becker and Stigler (1974). They used principle-agent model to explain that the effective payment will make the agent honest (incorruptible). Based on their research, Banfield (1975), Rose-Ackerman (1975, 1978) and Klitagarrd (1988, 1991) researched different methods to keep agents honest. Shleifer and Vishny (1993) studied the consequences of the corruption to the resource allocation. They believed that for a certain country, the structure of government institutions and the political process are very important determinants of the level of corruption and gave reasonable explanation why in some less developed countries, corruption is so high and so costly for development. Banerjee (1997) explained why government bureaucracies are often associated with red tape, corruption and lack of incentives. He identified two specific ingredients that together provide an explanation: the fact that governments often act precisely

[1] See Bardhan (1997).

in situation where markets fail and the presence of agency problems within the government. Tirole (1986, 1992), Laffont and Tirole (1993), Kfman and Lawree (1996), and Strausz (1997) studied the collusion (can be considered as corruption in a broader sense) between principle and supervisor in monitoring by principle-supervisor-agent hierarchy. Mookherjee and Png (1995), Polinsky (1999), Eskeland and Thiele (1999) studied corruption in institutions and organizations by moral hazard model.

Circumstantial evidence suggests that over the last 100 years corruption has generally declined with economic growth in most rich countries (and in some developing countries, like Singapore, it is reported to have declined quite fast in recent decades). The historical relationship between economic growth and corruption is thus likely to have been negative in general. However, in the process of transition from controlled to market economy in Eastern Europe, China, and Vietnam it has often been observed that there are some special factors increasing corruption even as income grows.

The reasons for the huge difference in corruption level between Singapore and China are worth researching. Among several approaches against bribery, an incentive pay structure in public administration is often cited as one of the most effective ways of fighting corruption. Current reforms in tax enforcement in many countries, which include a bonus to the tax officer based on the amount of taxes he or she collects, have often been associated with significant improvements in tax compliance (see, for example, Dilip Mookerjee

1995). In some cases (like in Singapore) a wage premium above private sector salaries has been found useful, consistent with the efficiency wage theory. The potential cost of job loss (including the wage premium and seniority benefits) on detection may reduce an official's temptation for corruption. International agencies pushing for structural adjustment policies sometimes ignore that, while deregulation reduces opportunities for corruption, another part of the same policy package aimed at drastic reductions of public spending may result in lower real wages for civil servants increasing their motivation for corruption.

2.2 The Anti-Corruption Reserving Fund System in Singapore

As we all know, Singapore is one the countries with fewest corruptions in the world (see Table 1). It has a strict anti-corruption system, in which the efficient accumulation fund system is one of the most important components to prevent government servants from taking bribe. The accumulation fund of civil servants, also called the anti-corruption reserving fund, is made up of two parts. One is 20% of the monthly wage of the government servants; the other is 13% subsidies given by the government. The longer period of time the person works and the higher his position is, the more the anti-corruption fund will be. If the public official didn't take bribes or commit other kinds of illegal behaviors, the entire accumulation fund under his name will be given to him when he retires, which will be more than enough for him and his family to enjoy a decent life after his retirement. However, if he is caught on corruptions, his accumulation fund will be confiscated by the government and he will also be brought to

justice. Here, the so-called corruption means receiving any kind of gift that worth 80 Singapore dollars or more without reporting to the superior officials, or borrow money from others without permission of the superior officials, etc. It is the incentive pay structure of the anti-corruption fund system that guarantees the civil servants in Singapore to maintain their integrity. The large sum of money after retirement is a kind of economic restriction for the in-service government servants. They are not willing to ruin the latter half of their lives for the current petty illegal profit.

2.3 The Current Situation of Anti-Corruption Reserving Fund in China

The Chinese provincial governments of Peking, Hunan, Jiangsu, Zhejiang and Guangdong, etc., are taking example by the methods used by Singapore in order to fight against corruption. They are carrying out the anti-corruption reserving fund system, hoping to effectively control government officials from taking bribes.

Since the implementation of the anti-corruption reserving fund system in China, it has attracted a lot of attentions. There are many people supporting this approach, while some others are opposed to it.

The scholars supporting the anti-corruption reserving fund system believe that it will increase the opportunity cost of committing corruption for the government servants so that it positively encourages people not to do any illegal behaviors. Besides, In practice, the anti-corruption reserving fund is a

more pragmatic way to prevent corruption than simply a one-time economic punishment since it is possible that some of the corruptible officials may hide their illegal gains in some secret accounts outside the country[2] and declare when arrested that they have used up all of their wealth and have nothing to be fined. On the contrary, the anti-corruption reserving fund can ensure that the potential fine is collected from the monthly income of government officials. Therefore, it will guarantee the enforcement of the economic punishment.

The dissenters consider that the current amount of anti-corruption fund is so little that it only has a limited function of warning. The so-called anti-corruption fund will not have a satisfactory effect to prevent wrongdoing. Also, if the government has to pay part of the accumulation fund, it will bring a huge burden to the fiscal budget. Finally, this system will increase the real income of the government servants. It will enlarge the income disparity between public officials and the public and tend to cause the social inequality.

This paper will make the payoff analysis of the anti-corruption reserving fund system from the perspective of the civil servants and the cost analysis from the perspective of the government respectively, and points out the corresponding conditions for the rationale and effectiveness of the system. Then, use a simple dynamic case to illustrate a more realistic phenomenon in China under the anti-corruption reserving fund system.

[2] The Department of Commerce of China estimates recently that there are more than 60 billion USD of illegal income from corruption is hiding outside of China's territory.

2 THE ANALYSIS FOR THE RATIONALE OF THE ANTI-CORRUPTION RESERVING FUND SYSTEM

2.1 The Baseline Model

Suppose the average gain from corruption is G per month and it will be a steady cash flow if the government official is still in office. His monthly wage as a government servant is denoted by w and it is exogenous. The monthly interest rate is r. If the illegal behavior of the government servant were detected in a certain month, he could still get the income and the illegal gain in that month, but he would not be able to get any income right after that month. The sanction due to corruption is denoted by S[3]. In reality, there would be a huge non-currency opportunity cost if the government servant were found out to commit corruption. His reputation would be seriously damaged. What is worse, some wrongdoers may be thrown into jail because of large amount of unlawful earnings. As a result, it will be extremely difficult for him to find another decent job and receive a steady income to support his latter life after getting out of prison. Here, we would only focus on the economic cost and return while ignoring the social cost and return. For the sake of simplicity, we assume that if the civil servant were found taking bribe, he could only get an outside (exogenous) wage, $\underline{w}$, which is normalized to be 0. The government

[3] S could be interpreted as fine and/or subsidy, since subsidy can be deemed as an unrealized income which may be withdrawn whenever an agent breaks government laws or regulations.

verifies the behavior of government officials in every period. More specifically, the probability of being detected of previous and current corruption (if any) is p by the government in each month, that is, once the government official takes bribe, the probability of being detected is p in every period from now on.

Since p is the average probability of being caught corruption for each month, it reflects the costly endeavors of the anti-corruption effort of the government. Therefore, the cost associated with the supervision effort of the government, C_1, is a function of p, where $C_1'(p) > 0, C_1''(p) > 0$. Meanwhile, there is a cost for the government to implement the sanction, $C_2(S)$ which is a non-decreasing function in S (for example, there would be a cost if S contains a subsidy from the government).

Then, the present value of the net return H_{in} of the incorruptible government servant is

$$H_{in} = \frac{w}{1+r} + \cdots + \frac{w}{(1+r)^n} \tag{1.1}$$

Suppose he will be able to work for the entire life, that is $n \to \infty$, then we get

$$\lim_{n\to\infty} H_{in} = \frac{w}{r} \tag{1.2}$$

However, for a corrupted government servant, we need to consider at which period he will start taking bribe.

Now, let us turn to the case in which the agent intends to be corruptible at some time before retirement.

Lemma 1.1: Given p is the probability of detecting corruptions (up to now) in each period, once a government official becomes corrupt, he will continuously take bribes until retirement.

Proof: For a government servant, he will keep on taking bribes if he has ever done it before. If he gives up corruption at the current period, he is obviously worse off since he would lose the gain from corruption without reducing the probability of being detected.

Q.E.D.

Lemma 1.2: A government official prefers to take bribe from the first period if any.

Proof: If a government servant chooses to take bribe from the beginning, then the present value of the net return $H_{co}(n)$ of the corrupted government servant given being caught at time n is

$$H_{co}(n)=\frac{G+w}{1+r}+\cdots+\frac{G+w}{(1+r)^n}-\frac{S}{(1+r)^n}=\left[(G+w)\frac{(1+r)^n-1}{r}-S\right]\frac{1}{(1+r)^n} \qquad (1.3)$$

The expected net return EH_{co} of the corrupted government agent given being caught at time n at the probability of detection at p is

$$\begin{aligned} EH_{co} &= H_{co}(1)p+H_{co}(2)(1-p)p+\cdots+H_{co}(n)(1-p)^{n-1}p \\ &=\left[(G+w)-S\right]\frac{1}{1+r}p+\cdots+\left[(G+w)\frac{(1+r)^n-1}{r}-S\right]\frac{1}{(1+r)^n}(1-p)^{n-1}p \qquad (1.4) \\ &=\frac{G+w}{r}\left[1-(1-p)^n-p\frac{1-\left(\frac{1-p}{1+r}\right)^n}{r+p}\right]-pS\frac{1-\left(\frac{1-p}{1+r}\right)^n}{r+p} \end{aligned}$$

$$\lim_{n\to\infty} EH_{co} = \frac{G+w-Sp}{r+p} \tag{1.5}$$

So, if he begins to take bribe at the first period, his life time expected return will turn out to be:

$$V_{co}^{1}(1) = \lim_{n\to\infty} EH_{co} = \frac{G+w-Sp}{r+p}$$

If he begins to take bribe at the second period, his life time expected return will be:

$$V_{co}^{1}(2) = \frac{w}{1+r} + \frac{V_{co}^{1}(1)}{1+r} = \frac{w}{1+r} + \frac{\dfrac{G+w-Sp}{r+p}}{1+r}$$

If he begins to take bribes at the n^{th} period, his life time expected return will be:

$$V_{co}^{1}(n) = \frac{w}{1+r} + \cdots + \frac{w}{(1+r)^{n-1}} + \frac{V_{co}^{1}(1)}{(1+r)^{n-1}} = \frac{w}{r} + \frac{1}{(1+r)^{n-1}}\left(\frac{G+w-Sp}{r+p} - \frac{w}{r}\right)$$

For a rational corruptible government servant, he will try to find a n such that $V_{co}^{1}(n)$ is maximized. We can see there are two possibilities:

1. When $\frac{G+w-Sp}{r+p} - \frac{w}{r} > 0$, the maximized expected return of the corrupted government servant can be reached at $n = 1$.
2. When $\frac{G+w-Sp}{r+p} - \frac{w}{r} \le 0$, the maximized expected return of the corrupt civil servant can be reached at $n \to \infty$. In another word, the gain from corruption is not big enough for the government servant to take bribe. The civil servant will maintain his integrity anyway.

Q.E.D.

Assume that a government official can work long enough, i.e., n can be very big, then when $\lim_{n\to\infty} H_{in} \le \lim_{n\to\infty} EH_{co}$, the government official will choose to take bribe; and when $\lim_{n\to\infty} H_{in} \ge \lim_{n\to\infty} EH_{co}$, the government official will choose not to take bribe. Therefore, which one is bigger will determine the existence of the anti-corruption reserving fund system. If $\lim_{n\to\infty} H_{in} < \lim_{n\to\infty} EH_{co}$, then

$$\frac{w}{r} < \frac{G+w-Sp}{r+p} \tag{1.6}$$

This inequality should be satisfied for civil servant to take bribe. It is the same as saying that when $\frac{w}{r} \ge \frac{G+w-Sp}{r+p}$, the government servant will choose no to take bribe. The left hand side of (1.6) is the life time income of the incorruptible government servant. The right hand side is the life time expected income of the corrupted government servant. Notice, $r+p$ can be deemed as the discount rate to the corrupted government servant[4].

Rearrange the equation, we can get $\frac{w}{r} + \frac{Sp}{r+p} \ge \frac{G+w}{r+p}$. Here, it can be seen that S may also be regarded as an economic reward to the incorruptible government servant other than a punishment to the corrupted government servant.

For a specific supervision level, in order to prevent corruption, we need

$$S \ge \frac{G}{p} - \frac{w}{r} \tag{1.7}$$

[4] It is equivalent to deem that the corrupt official has a certain instantaneous income of $G+w-Sp$ in Each period, but faces a higher discount rate as $r+p$.

$\frac{G}{p}$ in (1.7) is the discounted gain of corruption and $\frac{w}{r}$ is the expected life time income.

From above analysis, we could get the following results:

Result 1: For the necessary condition of the anti-corruption reserving fund system exists, i.e., $S = \frac{G}{p} - \frac{w}{r} \geq 0$, we need

$$\frac{G}{p} - \frac{w}{r} \geq 0 \quad \text{or} \quad \frac{G}{p} \geq \frac{w}{r} \tag{1.8}$$

If $\frac{G}{p} - \frac{w}{r} \leq 0$, we don't need the anti-corruption reserving fund system at all since corruption can be prevented without any additional penalty other than the opportunity cost of losing current job.

Rearrange (1.8), we can get the minimum supervision level p without any sanction scheme is given by $p^N = \frac{rG}{w}$. If $p \geq \frac{rG}{w}$, i.e., the supervision level of detecting corruption in a country is excellent, so there will be no need of the existence of the anti-corruption reserving fund system; however, if $p < \frac{rG}{w}$, or the monitoring of the corruption in a country is poor, the anti-corruption reserving fund system will be a decent supplementary arrangement to prevent corruption.

Result 2: A rational government will not waste any money so that the inequality will turn out to be an equality, i.e.

$$\frac{w}{r} = \frac{G + w - Sp}{r + p} \quad \text{or} \quad S = \frac{G}{p} - \frac{w}{r}. \tag{1.9}$$

Rearrange this equation, we will get

$$p^S = \frac{rG}{w+rS} \tag{1.10}$$

Compared with p^N, p^S is strictly smaller for any positive S so that the sanction can effectively lower the cost of supervision level $C_1(p)$. (see figure 1)

It is interesting to check how the parameters (S, G, w, r) affect the saving of cost on supervision. First of all, an increase in S will only lower p^S so that the saving, $SA = C_1(p^N) - C_1(p^S)$, is enlarged. Secondly, we can find that SA is increasing in G and r, but decreasing in w.[5] All the above results implies that an increase in the gain from corruption or an increase in the interest rate will magnify the effects of the sanction on cost savings while an increase in wage will have the opposite effect.

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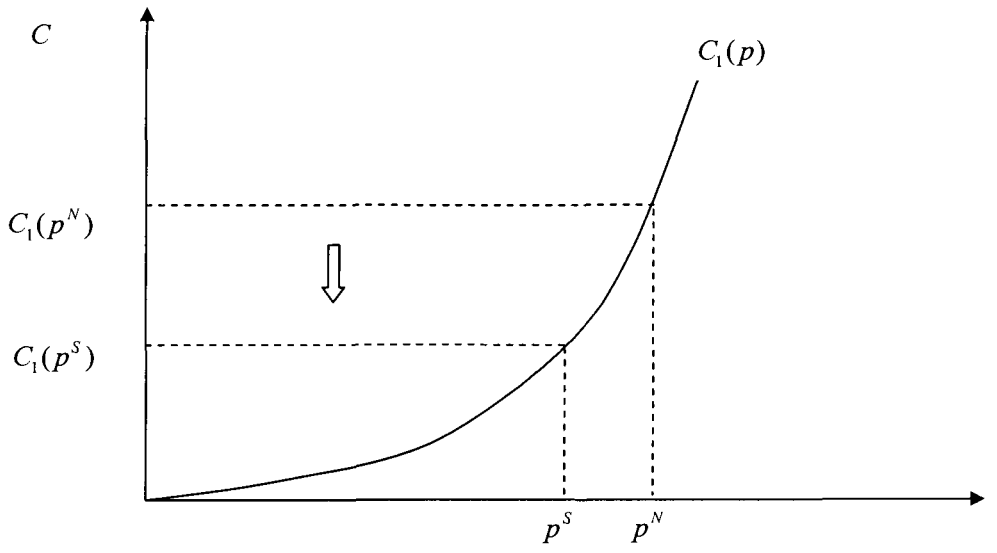
[5] If we take derivative w.r.t. G, we have $C_1'\left(\frac{rG}{w}\right)\frac{r}{w} - C_1'\left(\frac{rG}{w+rS}\right)\frac{r}{w+rS} > 0$ since $C_1'\left(\frac{rG}{w}\right) > C_1'\left(\frac{rG}{w+rS}\right)$ (C is convex) and $\frac{r}{w} > \frac{r}{w+rS}$. Next, if we take derivative w.r.t. r, we will have $C_1'\left(\frac{rG}{w}\right)\frac{G}{w} - C_1'\left(\frac{rG}{w+rS}\right)\frac{Gw}{(w+rS)^2} < 0$ since $C_1'\left(\frac{rG}{w}\right) > C_1'\left(\frac{rG}{w+rS}\right)$ and $\frac{G}{w} > \frac{Gw}{(w+rS)^2}$. Finally, if we take derivative w.r.t. w, we will get $C_1'\left(\frac{rG}{w}\right)\frac{rG}{w^2} - C_1'\left(\frac{rG}{w+rS}\right)\frac{rG}{(w+rS)^2} < 0$ since $C_1'\left(\frac{rG}{w}\right) > C_1'\left(\frac{rG}{w+rS}\right)$ and $\frac{rG}{w^2} > \frac{rG}{(w+rS)^2}$.

Figure 1 Supervision cost with/without sanction



Since $C_1 = C_1(p)$ where $C_1'(p) > 0, C_1''(p) > 0$, $C(p)$ could be very high especially when G is very big relatively to w (so that p^N will be very high). That's why the government will seek other ways, like the anti-corruption reserving fund to reach a better anti-corruption outcome. In reality, the governments in Singapore and Hong Kong choose to have good supervision system and the anti-corruption reserving fund system at the same time and get quite good anti-corruption results. This is a supportive demonstration of conclusions drawn above. In China, more and more people now realize that supervision combined with reasonable economic reward and punishment is a much better anti-corruption approach. So, they have been taking the anti-corruption reserving fund system as an important subsidy for supervision.

2.2 The Extended Model with the Anti-corruption Reserving Fund System

2.2.1 Payoff Analysis of the Civil Servant with Anti-Corruption Reserving Fund System

Whether the anti-corruption reserving fund system will be efficient or not depends on whether it can prevent corruption and promote the wellbeing of the individuals and the nation effectively. For a particular government servant, he will compare the payoff of being incorruptible and corruptible under the arrangement of anti-corruption reserving fund system according to his current information.

Based on the baseline model, first suppose that the government servant is risk-neutral. His monthly income is w . The anti-corruption reserving fund will consist of b_1 (percentage) of his monthly income and b_2 (percentage) of the governmental subsidy. That is, $b_1 w$ is the monthly endowment to the anti-corruption fund as a potential penalty while $b_2 w$ is the potential award. The average gain from corruption is G per month and it will be a steady cash flow if the government official is still in office. If the anti-law behavior is caught by the government, he can still get the income and the illegal gain in that month, but he will not be able to get any income starting from next month and his entire accumulation fund will be confiscated by the government. The behavior of corruption will be detected at the n^{th} years. The monthly interest rate is r. Finally, assume the probability of detecting corruption is p for each month and it is a constant.

If the government servant chooses to be incorruptible, his net return R_{in} [6] will be

$$R_{in} = \frac{w(1+b_2)}{1+r} + \cdots + \frac{w(1+b_2)}{(1+r)^n} \tag{2.1}$$

$$\lim_{n\to\infty} R_{in} = \frac{w(1+b_2)}{r} \tag{2.2}$$

Now, let's consider the case if a government official intends to take bribe sometime before retirement.

Lemma 2.1: Given p is the probability of detecting corruptions (up to now) in each period, once a government official becomes corrupt, he will continuously take bribes until retirement.

Proof: See Proof for Lemma 1.1.

Lemma 2.2: A government official prefers to take bribe from the first period if any.

Proof: If a government servant chooses to take bribe from the beginning, his net return $R_{co}(n)$ given being caught at n^{th} year will be

$$R_{co}(n) = \frac{G + w(1-b_1)}{1+r} + \cdots + \frac{G + w(1-b_1)}{(1+r)^n} = \left[G + w(1-b_1)\right]\frac{(1+r)^n - 1}{r} \tag{2.3}$$

---

[6] Because if the government servant chooses to be incorruptible, though he can only get a monthly income of $w(1-b_1)$ (suppose the government deposits wb_1 and wb_2 into a bank which pays the interest at the rate of r each month), he will certainly get the anti-corruption fund after retirement, so his actual monthly income should be $w(1-b_1)+w(b_1+b_2)$ or $w(1+b_2)$.

If his anti-law behavior being caught has the probability of p in each month throughout n years, his expected net return ER_{co} will be

$$\begin{aligned} ER_{co} &= R_{co}(1)p + R_{co}(2)(1-p)p + \cdots + R_{co}(n)(1-p)^{n-1}p \\ &= \left[G + w(1-b_1)\right]\frac{(1+r)^1 - 1}{r}p + \cdots + \left[G + w(1-b_1)\right]\frac{(1+r)^n - 1}{r}(1-p)^{n-1}p \qquad (2.4) \\ &= \frac{G + w(1-b_1)}{r}\left[1 - (1-p)^n - p\frac{1 - \left(\frac{1-p}{1+r}\right)^n}{r+p}\right] \end{aligned}$$

$$\lim_{n\to\infty} ER_{co} = \frac{G + w(1-b_1)}{r+p} \qquad (2.5)$$

Therefore, if he begins to take bribe at the first period, his life time expected return will be:

$$V_{co}^2(1) = \lim_{n\to\infty} ER_{co} = \frac{G + w(1-b_1)}{r+p}$$

If he begins to take bribe at the second period, his life time expected return will be:

$$V_{co}^2(2) = \frac{w(1-b_1)}{1+r} + \frac{V_{co}^2(1)}{1+r} = \frac{w(1-b_1)}{1+r} + \frac{\frac{G + w(1-b_1)}{r+p}}{1+r}$$

If he begins to take bribe at the n^{th} period, his life time expected return will be:

$$V_{co}^2(n) = \frac{w(1-b_1)}{1+r} + \cdots + \frac{w(1-b_1)}{(1+r)^{n-1}} + \frac{V_{co}^2(1)}{(1+r)^{n-1}} = \frac{w(1-b_1)}{r} + \frac{1}{(1+r)^{n-1}}\left[\frac{G + w(1-b_1)}{r+p} - \frac{w(1-b_1)}{r}\right]$$

For a rational corrupted government servant, he will find a n such that $V_{co}^2(n)$ is maximized. We can see there are two possibilities:

1. When $\frac{G + w(1-b_1)}{r+p} - \frac{w(1-b_1)}{r} > 0$, the maximized expected return of the

corrupted civil servant can be reached at $n=1$.

2. When $\frac{G+w(1-b_1)}{r+p}-\frac{w(1-b_1)}{r}\leq 0$, the maximized expected return of the corrupted civil servant can be reached at $n\to\infty$. In another word, the gain from corruption is not big enough for the civil servant to take bribe. The civil servant will not take bribe anyway.

Q.E.D.

From the above analysis, the inequality

$$\frac{G+w(1-b_1)}{r+p}-\frac{w(1-b_1)}{r}>0$$

(2.6)

(2.6) should be satisfied to have the civil servant to be corruptible, and the corrupted government servant will always choose to take bribe at the first period. Once he starts to take bribe, he will continue to take bribe until retirement.

Under the anti-corruption reserving fund system, the government servant will choose to take bribe only if he can get a higher expected return when he takes bribe than he does not. That is, $\lim_{n\to\infty} R_{in} < \lim_{n\to\infty} ER_{co}$ should be satisfied to guarantee the corrupt behavior of the servant when anti-corruption reserving fund system is carried out. So, we can get

$$\frac{w(1+b_2)}{r}<\frac{G+w(1-b_1)}{r+p} \qquad (2.7)$$

It is clear that the inequality (2.6) will be satisfied automatically when

inequality (2.7) is hold. So when $\frac{w(1+b_2)}{r} \geq \frac{G+w(1-b_1)}{r+p}$, the government servant will choose to be incorruptible.

Comparing 2.1 with 2.2.1., we can see the following results:

Result 1: w is the monthly income of a government servant. $b_1 w$ is a portion of his income that is taken away as part of the accumulation fund. If the servant is detected of corruption, he will not be able to get the money. Therefore, $b_1 w$ can be regarded as a punishment to the corrupted government servants. $b_2 w$ is the subsidy of the government to the official in order to prevent corruption. If the government servant is incorruptible, he can get the money after his retirement, so it can be considered as a reward to the incorruptible government servants.

By (2.7), we can get

$$\frac{w(1+b_2)}{r} = \frac{G+w(1-b_1)}{r+p} \tag{2.8}$$

From (2.8), we can derive a new threshold of supervision level using the anti-corruption reserving fund $p^F = \frac{r[G-w(b_1+b_2)]}{w(1+b_2)}$. Now, let's check how the parameters (b_1, b_2, G, w, r) affect the saving of cost on supervision.

Firstly, It is obvious that an increase in b_1 and b_2 will only decrease p^F so that the saving, $SA = C_1(p^N) - C_1(p^F)$, will be enlarged.

Secondly, we can find that SA is increasing in G and r, but

decreasing in w.[7] All the above results implies that an increase in the gain from corruption or an increase in the interest rate will magnify the effect of the sanction on cost savings while an increase in wage will have the opposite effect.

Rearrange (2.8), we get

$$\frac{w}{r} = \frac{G+w}{r+p} - \frac{wb_2}{r} - \frac{wb_1}{r+p} \tag{2.9}$$

From (1.9), we have

$$\frac{w}{r} = \frac{G+w-Sp}{r+p} \tag{1.9}$$

Equalize the right hand side parts of (1.9) and (2.9)

$$\frac{wb_2}{r} + \frac{wb_1}{r+p} = \frac{Sp}{r+p}$$

Rearrange it, we get

$$S = \frac{rwb_1 + (r+p)wb_2}{pr} = \frac{w\left[rb_1 + (r+p)b_2\right]}{pr} \tag{2.10}$$

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[7] If we take derivative w.r.t. G, we have $C_1'\left(\frac{rG}{w}\right)\frac{r}{w} - C_1'\left(\frac{r\left[G-w(b_1+b_2)\right]}{w(1+b_2)}\right)\frac{r}{w(1+b_2)} > 0$ since $C_1'\left(\frac{rG}{w}\right) > C_1'\left(\frac{r\left[G-w(b_1+b_2)\right]}{w(1+b_2)}\right)$ (C is convex) and $\frac{r}{w} > \frac{r}{w(1+b_2)}$. Next, if we take derivative w.r.t. r, we will have $C_1'\left(\frac{rG}{w}\right)\frac{G}{w} - C_1'\left(\frac{r\left[G-w(b_1+b_2)\right]}{w(1+b_2)}\right)\frac{G-w(b_1+b_2)}{w(1+b_2)} > 0$ since $C_1'\left(\frac{rG}{w}\right) > C_1'\left(\frac{r\left[G-w(b_1+b_2)\right]}{w(1+b_2)}\right)$ and $\frac{G}{w} > \frac{G-w(b_1+b_2)}{w(1+b_2)}$. Finally, if we take derivative w.r.t. w, we will get $-\left\{C_1'\left(\frac{rG}{w}\right)\frac{rG}{w^2} - C_1'\left(\frac{r\left[G-w(b_1+b_2)\right]}{w(1+b_2)}\right)\frac{rG}{w^2(1+b_2)}\right\} < 0$ since $C_1'\left(\frac{rG}{w}\right) > C_1'\left(\frac{r\left[G-w(b_1+b_2)\right]}{w(1+b_2)}\right)$ and $\frac{rG}{w^2} > \frac{rG}{w^2(1+b_2)}$.

In (2.10), rwb_1 is the discounted contribution to the accumulation fund from the civil servant; $(r+p)wb_2$ is the discounted contribution to the accumulation fund from the government. Therefore, S in 2.1 has actually been divided into two parts. One is part of the salary of the government servant; the other is the government subsidy. It is clear that the model in 2.2.1. is just an extension of the model in 2.1 that we separate the economic penalty into two parts, penalty and reward.

Result 2: From $\frac{w(1+b_2)}{r} = \frac{G+w(1-b_1)}{r+p}$, we can see that b_2 is a function of b_1, or $b_2 = f(b_1)$ where $f'(b_1) < 0$. The cost of the government associated with the anti-corruption reserving fund system is $C_2 = C_2(M)$. Let's assume $C_2 = f(wb_2) = \frac{wb_2}{r}$. Therefore, the government will intend to increase b_1 in order to bring its cost down. However, there should be a maximum value for b_1 since the government official needs at least a certain fraction of his monthly income to finance his necessary consumption and expenditure. Suppose $\tilde{b}_1$ is the maximum value for b_1.[8] For a rational government, it will set its optimal level of $\tilde{b}_2$ at $\tilde{b}_2 = f(\tilde{b}_1)$.

[8] The monthly wage for the government officials should better be equal or greater than his necessary expense which is assumed as $\bar{E}$. That is to say, $w(1-b_1) \geq \bar{E}$. For a rational government, it will choose $w(1-b_1) = \bar{E}$, so we can get $\tilde{b}_1$.

2.2.2 Cost Analysis of the Government with the Anti-corruption Reserving Fund System

As for a government, it will consider the benefit and cost of carrying out the anti-corruption reserving fund system. If the cost of the system is so high that it will result in a big budget deficit, the government would never like to have it. Only when the social benefit is equal or greater than the cost, the government will be willing to carrying out the system. For the sake of simplicity, I will assume that the social benefit is exogenous and big enough so that the government will always choose to prevent corruption. Then the problem of a rational government is to choose the-minimum-cost approach to carry out the anti-corruption reserving fund system.

As mentioned in section 2.1 and 2.2.1., there are two kinds of costs associated with the anti-corruption reserving fund system. One is $C_1(p)$ where $C_1'(p) > 0, C_1''(p) > 0$, the other is $C_2(wb_2) = \frac{wb_2}{r}$. Given (2.8) and $\tilde{b}_1$, we know

$$\frac{w(1+b_2)}{r} = \frac{G + w(1-b_1)}{r+p} \tag{2.8}$$

Therefore,

$$\tilde{b}_2 = \frac{rG - rw\tilde{b}_1 - wp}{w(r+p)} \tag{2.11}$$

So

$$C_2(w\tilde{b}_2) = w\frac{rG - rw\tilde{b}_1 - wp}{wr(r+p)} = \frac{rG - rw\tilde{b}_1 - wp}{r(r+p)} = C_2(p) \tag{2.12}$$

Since $rG - rw\tilde{b}_1 - wp > 0$,

$$C_2'(p) = \frac{-w(r+p) - (rG - rw\tilde{b}_1 - wp)}{(r+p)^2} < 0$$

The total cost of carrying out the anti-corruption reserving fund system will be

$$C(p) = C_1(p) + C_2(p) \tag{2.13}$$

For the rational government, it will minimize the total cost associated with the anti-corruption reserving fund system, that is

$$\underset{p}{Min}\left(C_1(p) + C_2(p)\right) \tag{2.14}$$

If the first order condition exists, i.e., we can find a p^* such that

$$C_1'(p^*) + C_2'(p^*) = 0$$

(2.15)

Then $p^*(w, r, G, \tilde{b}_1)$ is the optimal p that minimizes the total cost of the anti-corruption reserving fund system.[9]

In reality, the government will make the decision on how to prevent corruption according to the current information it has, like the average income of the government servant, interest rate, the portion of the anti-corruption reserving fund paid by the government servant, and the average gain from corruption for a certain government servant.

Given the anti-corruption reserving fund is rational, we can comment that if the current supervision level is smaller than p^*, the government should pay more attention to strengthen supervision of anti-law behaviors in order to

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[9] It is easy to check this is a minimum rather than a maximum. The SOC is $C_1''(p) + C_2''(p)$. Since $C_1''(p) > 0$ by assumption; $C_1''(p) = \frac{2(rG + wr - rw\tilde{b}_1)}{(r+p)^3} > 0$, $C_1''(p) + C_2''(p) > 0$.

bring the total cost down. If the current supervision level is greater than p^*, it is better for the government to decrease supervision level moderately and increase the economic reward to the incorruptible government officials.

2.2.3 The Necessary and Sufficient Condition for the Existence of the Anti-Corruption Reserving Fund System

As analyzed in section 2.1, from the necessary condition of the existence of economic punishment (reward) as a way to prevent corruption, we get the threshold of not having the economic punishment (reward) is

$$S = \frac{G}{p} - \frac{w}{r} = 0 \quad \text{or} \quad p^N = \frac{rG}{w} \tag{1.10}$$

So, $\tilde{p}$ is the maximum supervision level which requires economic punishment (reward) to prevent corruption.

If dividing S into two parts, punishment and reward, we will be able to get the necessary condition of the existence of the anti-corruption reserving fund,

$$\because \quad S = \frac{w\left[(r+p)b_2 + r\tilde{b}_1\right]}{pr} \tag{2.10}$$

$$\therefore \quad wb_2 = \frac{prS - wr\tilde{b}_1}{p+r} \tag{2.16}$$

Because wb_2 should be greater than 0 to guarantee the existence of the subsidy in the anti-corruption reserving fund system, we have

$$wb_2 = \frac{prS - wr\tilde{b}_1}{p+r} \geq 0 \tag{2.17}$$

Rearrange it, we get

$$prS - wr\tilde{b}_1 \geq 0 \quad \text{or} \quad S \geq \frac{w\tilde{b}_1}{p} \tag{2.18}$$

For a rational government,

$$S = \frac{w\tilde{b}_1}{p} \tag{2.19}$$

Let

$$S = \frac{w\tilde{b}_1}{p} \geq \frac{G}{p} - \frac{w}{r} \tag{2.20}$$

We get

$$p \geq \frac{r(G - w\tilde{b}_1)}{w} \tag{2.21}$$

Therefore, the threshold of not having the subsidy portion of the anti-corruption fund system is

$$p^{SU} = \frac{r(G - w\tilde{b}_1)}{w} \tag{2.22}$$

This is the maximum supervision level to have subsidy in the anti-corruption reserving fund system. [10] More practically, only if the supervision level is smaller than p^{SU}, there will be a subsidy from the government to sustain the anti-corruption reserving fund system.

In conclusion, we can draw the following graph.

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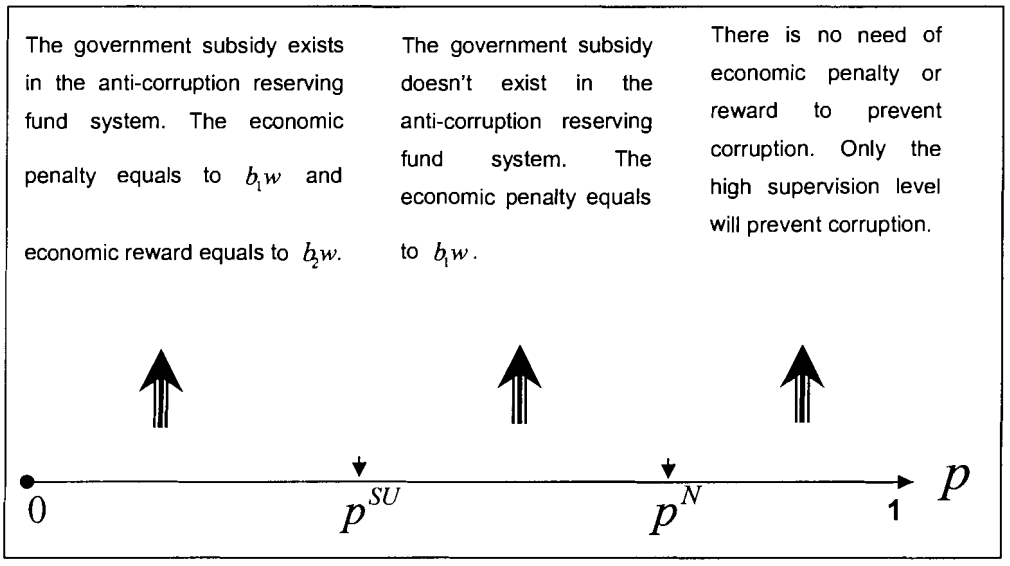
[10] Because $S \geq \frac{G}{p} - \frac{w}{r}$ should be satisfied. When p is big enough, the anti-corruption reserving fund system will not exist. As p is decreasing, S should also be increasing to satisfy the inequality. At first, the government will increase b_1 since it will bring no cost to the government in preventing corruption. As long as b_1 reaches $\tilde{b}_1$, the government will have to increase b_2.

Figure 2 The ways to prevent corruption at different supervision level



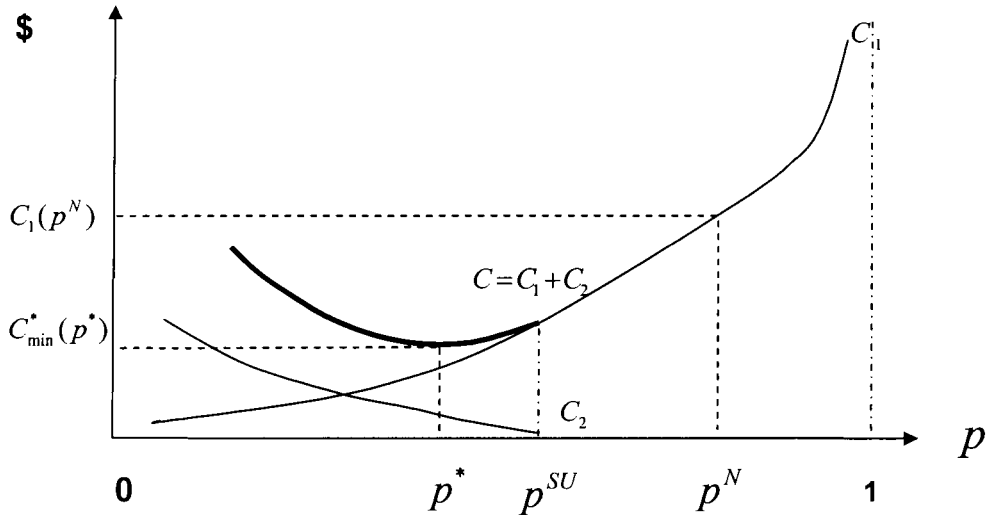
The situation is, when government wants to prevent corruption, it will first set a high supervision level. However, this high probability of detecting wrongdoing will bring an extremely high cost to the government so that it will not be able to last for a long time. At this point, the government will introduce an economic penalty equals to b_1w and bring down the cost of supervision. Because b_1w will induce no cost to the government, a rational government will tend to increase b_1w to $\tilde{b}_1w$ and maintain the supervision level of p^{SU}. If the government still wants to reduce the supervision level. The only way is to give an economic subsidy equals to b_2w. A big enough government subsidy combined with a low supervision level will also be able to prevent corruption.

So, the necessary and sufficient condition for the existence of the government reward in the anti-corruption reserving fund system is $0 \le p \le p^{SU}$

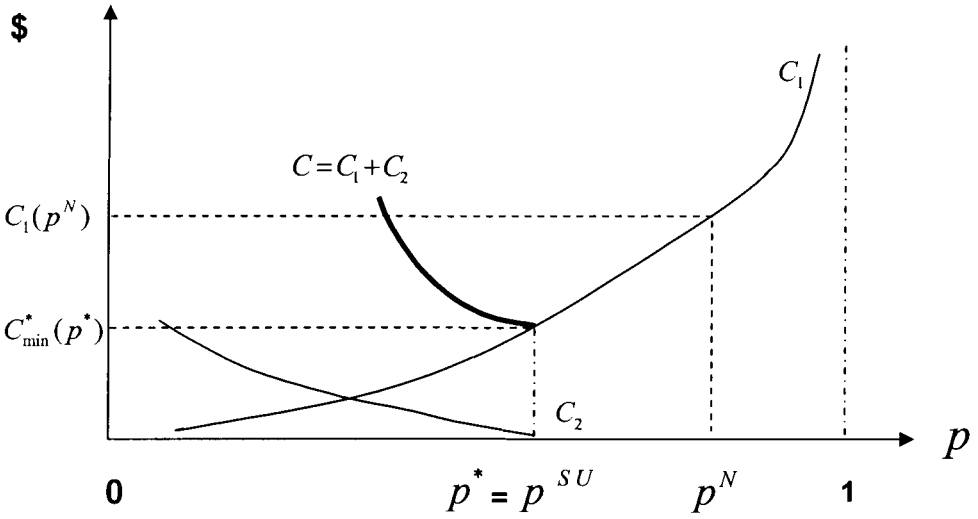
and the necessary and sufficient condition for the existence of the anti-corruption reserving fund system is $0 \leq p \leq p^N$.

From the above analysis, we can see that supervision is the key element in fighting against corruption and the anti-corruption reserving fund system is an effective complementary approach to prevent corruption. Therefore, C_1 will always exist and the existence of C_2 will depend on the supervision level of the government. From the government's point of view, it will choose the cost-minimized way to prevent corruption. There will be two kinds of equilibrium. The first one is showed in Case A of Table 2 that the government will provide a subsidy to the incorruptible civil servants. The other is showed in Case B of Table 2 that the government will not provide a subsidy because pure supervision will have a lower cost than combined supervision and government subsidy.

Figure 3 The total cost of anti-corruption reserving fund and optimal supervision level



Case A



Case B

2.3 A Simple Dynamic Case

In the real world, the gain from corruption is highly related to the official ranks of the government officials. Normally, the government official with higher official ranking in China will have a higher gain from corruption because he has a greater power over the things in his charge. Besides, the government official usually will be promoted throughout his life time if he is not detected of any illegal behaviors. This is one of the most obvious characteristics of working as civil servants in China. Then, the above facts will make the dynamic analyses of the anti-corruption reserving fund system possible.

Suppose that the gain from corruption, G, in each month suits the following formula

$$G_t = G_0^{t\alpha} \quad \text{where } \alpha > 0 \tag{2.23}$$

The government servant will get promoted if he is not detected of any illegal behaviors, that is

$$w_t = \gamma w_{t-1} \text{ where } \gamma \geq 1 + r \text{ and exogenous} \tag{2.24}$$

Therefore

$$w_1 = \gamma w_0 \quad w_2 = \gamma w_1 \quad w_3 = \gamma w_2 \quad \cdots$$

So

$$w_t = \gamma^t w_0 \tag{2.25}$$

If the government servant chooses to be incorruptible, his net return $V_{in}(T)$ for T period will be

$$V_{in}(T)=\frac{w_1(1+b_2)}{1+r}+\cdots+\frac{w_T(1+b_2)}{(1+r)^T}$$
$$=\sum_{t=1}^{T}\frac{w_0\gamma^T(1+b_2)}{(1+r)^T} \qquad (2.26)$$
$$=w_0(1+b_2)\frac{\gamma\left[1-\left(\frac{\gamma}{1+r}\right)^T\right]}{1+r-\gamma}$$

Again, let's turn to the case in which the agent intends to be corruptible at some time before retirement.

Lemma 3.1: Given p is the probability of detecting corruptions (up to now) in each period, once a government official becomes corrupt, he will continuously take bribes until retirement.

Proof: see proof for Lemma 1.1.

A government official prefers to take bribe from $t^*(w_0,G_0,\gamma,\alpha,b_1,r,T,p)$ when his expected income in T years will be maximized.

We can see this from the following analysis:

If a government servant chooses to take bribe from the beginning, his net return $V_{co}(T)$ given being caught at time T will be

$$V_{co}(T)=\frac{G_0^{\alpha}+w_1(1-b_1)}{1+r}+\cdots+\frac{G_0^{T\alpha}+w_T(1-b_1)}{(1+r)^T}=\frac{G_0^{\alpha}+\gamma w_0(1-b_1)}{1+r}+\cdots+\frac{G_0^{T\alpha}+\gamma^T w_0(1-b_1)}{(1+r)^T}$$
$$=\frac{G_0^{\alpha}\left[1-\left(\frac{G_0^{\alpha}}{1+r}\right)^T\right]}{1+r-G_0^{\alpha}}+\frac{[w_0(1-b_1)]\gamma\left[1-\left(\frac{\gamma}{1+r}\right)^T\right]}{1+r-\gamma} \qquad (2.28)$$

If his illegal behavior is detected with the probability of p in each month throughout T years, his expected net return EV_{co} will be

$$EV_{co}(T)=V_{co}(1)p+V_{co}(2)(1-p)p+\cdots+V_{co}(T)(1-p)^{T-1}p$$

$$=\left\{\frac{G_0^{\alpha}\left[1-\left(\frac{G_0^{\alpha}}{1+r}\right)^{1}\right]}{1+r-G_0^{\alpha}}+\frac{[w_0(1-b_1)]\gamma\left[1-\left(\frac{\gamma}{1+r}\right)^{1}\right]}{1+r-\gamma}\right\}p+\cdots+\left\{\frac{G_0^{\alpha}\left[1-\left(\frac{G_0^{\alpha}}{1+r}\right)^{T}\right]}{1+r-G_0^{\alpha}}+\frac{[w_0(1-b_1)]\gamma\left[1-\left(\frac{\gamma}{1+r}\right)^{T}\right]}{1+r-\gamma}\right\}(1-p)^{T-1}p \quad (2.29)$$

$$=\frac{G_0^{\alpha}p}{1+r-G_0^{\alpha}}\left[\frac{1-(1-p)^{T}}{p}-G_0^{\alpha}\frac{1-\left[\frac{G_0^{\alpha}(1-p)}{1+r}\right]^{T}}{1+r-G_0^{\alpha}(1-p)}\right]+\frac{[w_0(1-b_1)]\gamma p}{1+r-\gamma}\left[\frac{1-(1-p)^{T}}{p}-\gamma\frac{1-\left[\frac{\gamma(1-p)}{1+r}\right]^{T}}{1+r-\gamma(1-p)}\right]$$

$$EV_{co}(T)=\frac{G_0^{\alpha}p}{1+r-G_0^{\alpha}}\left[\frac{1-(1-p)^{T}}{p}-G_0^{\alpha}\frac{1-\left[\frac{G_0^{\alpha}(1-p)}{1+r}\right]^{T}}{1+r-G_0^{\alpha}(1-p)}\right]+\frac{[w_0(1-b_1)]\gamma p}{1+r-\gamma}\left[\frac{1-(1-p)^{T}}{p}-\gamma\frac{1-\left[\frac{\gamma(1-p)}{1+r}\right]^{T}}{1+r-\gamma(1-p)}\right] \quad (2.30)$$

Therefore, if he begins to take bribe from the first period, his expected return at time T will be:

$$V_{co}^{3}(1)=EV_{co}(T)=\frac{G_0^{\alpha}p}{1+r-G_0^{\alpha}}\left[\frac{1-(1-p)^{T}}{p}-G_0^{\alpha}\frac{1-\left[\frac{G_0^{\alpha}(1-p)}{1+r}\right]^{T}}{1+r-G_0^{\alpha}(1-p)}\right]+\frac{[w_0(1-b_1)]\gamma p}{1+r-\gamma}\left[\frac{1-(1-p)^{T}}{p}-\gamma\frac{1-\left[\frac{\gamma(1-p)}{1+r}\right]^{T}}{1+r-\gamma(1-p)}\right]$$

If he begins to take bribe from the second period, his expected return at time T will be:

$$V_{co}^{3}(2)=\frac{w_1(1-b_1)}{1+r}+\frac{EV_{co}(T-1)}{1+r}$$

If he begins to take bribe from the t^{th} year, his life time expected return

at time T will be:

$$V_{co}^{3}(t)=\frac{w_1(1-b_1)}{1+r}+\cdots+\frac{w_{t-1}(1-b_1)}{(1+r)^{t-1}}+\frac{EV_{co}(T-t)}{(1+r)^{t-1}} \tag{2.31}$$

For a rational corrupted government servant, he will choose the t that maximizes $V_{co}^{3}(t)$.

$$\underset{t}{Max}\left[\frac{w_1(1-b_1)}{1+r}+\cdots+\frac{w_{t-1}(1-b_1)}{(1+r)^{t-1}}+\frac{EV_{co}(T-t)}{(1+r)^{t-1}}\right] \tag{2.32}$$

Given suitable parameters, we will be able to get a $t^{*}(w_0,G_0,\gamma,\alpha,b_1,r,T,p)$ such that when the civil servant starts to take bribe from period t, he would maximize the expected net return in T years. So, from which period the corrupted civil servant will start to take bribe depends on the value of $w_0,G_0,\gamma,\alpha,b_1,r,T$ and p.

However, the calculation for the strict solution of t^{*} is a challenging work. An easier way to show how it works is just considering the corruptible civil servant's choice of starting corruption in year t or $t+1$.

If the corrupted civil servant starts to take bribe from the t^{th} year, his present value of expected net return from the t^{th} year to the T^{th} year at the beginning of period t is

$$V_{co}(T-t)=\frac{w_t(1-b_1)+G_t}{1+r}+\frac{(1-p)EV_{co}(T-t-1)}{1+r} \tag{2.33}$$

If the corruptible civil servant starts to take bribe from the $(t+1)^{th}$ year, his present value of expected net return from the t^{th} year to the T^{th} year at the beginning of period t is

$$V_{co}'(T-t)=\frac{w_t(1-b_1)}{1+r}+\frac{EV_{co}(T-t-1)}{1+r} \tag{2.34}$$

$V_{co}(T-t)$ versus $V_{co}'(T-t)$ is the same as G_t versus $pEV_{co}(T-t-1)$. G_t is the extra gain from corruption if the civil servant chooses to take bribe at period t rather than $t+1$; $pEV_{co}(T-t-1)$ is the opportunity cost of doing so because the earlier corruption will have a probability of p of being dead so that he cannot realize the corruption value $EV_{co}(T-t-1)$ in the next period. Comparing G_t and $pEV_{co}(T-t-1)$, we can see that when $G_t > pEV_{co}(T-t-1)$, the corrupted civil servant will start taking bribe from the t^{th} year. Meanwhile, when $G_t < pEV_{co}(T-t-1)$, the corrupted civil servant will start taking bribe from the $(t+1)^{th}$ year.

Since

$$G_t = G_0{}^{t\alpha}$$

(2.23)

And

$$pEV_{co}(T-t-1)=\frac{G_0^{\alpha}p^2}{G_0^{\alpha}-1-r}\left\{G_0^{\alpha}\frac{\left[\frac{G_0^{\alpha}(1-p)}{1+r}\right]^{T-t-1}-1}{G_0^{\alpha}(1-p)-1-r}\frac{1-(1-p)^{T-t-1}}{p}\right\}+\frac{w_0(1-b_1)\gamma p^2}{\gamma-1-r}\left\{\gamma\frac{1-\left[\frac{\gamma(1-p)}{1+r}\right]^{T-t-1}}{1+r-\gamma(1-p)}\frac{1-(1-p)^{T-t-1}}{p}\right\} \tag{2.35}$$

It is evident that G_t is increasing in t[11]. However $pEV_{co}(T-t-1)$ is decreasing in t[12]. At a certain t, if $G_t > pEV_{co}(T-t-1)$, the corrupted civil

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[11] t is the year the corruptible civil servant starts to take bribe. It can also be consider as the number of working years being incorruptible. Moreover, based on my model, the higher the t is, the higher official rank of the civil servant will be.

[12] $\frac{1-(1-p)^{T-t-1}}{p}$ is very small compared with $\left[\frac{G_0^{\alpha}(1-p)}{1+r}\right]^{T-t-1}$ and $\left[\frac{\gamma(1-p)}{1+r}\right]^{T-t-1}$. So its effect can be omitted.

$\left[\frac{G_0^{\alpha}(1-p)}{1+r}\right]^{T-t-1}$ is decreasing in t no matter $\gamma^{\alpha}(1-p)-1-r>0$ or $\gamma^{\alpha}(1-p)-1-r<0$. $\left[\frac{\gamma(1-p)}{1+r}\right]^{T-t-1}$ is also

servant should choose to take bribe in the earlier period, while if $G_t < pEV_{co}(T-t-1)$, the corrupted civil servant should choose to take bribe in the later period in order to get a higher expected return from corruption. Therefore, there should be a t^* such that $G_t = pEV_{co}(T-t-1)$, The civil servant will definite start to take bribe at t^* and his expected return of corruption will be maximized.

For the suitable value of the parameters $w_0, G_0, \gamma, \alpha, b_1, r, T$ and p, it is possible to get $t^* = T$. Under such conditions, starting taking bribe at the last few years before retirement will maximize the expected return from corruption of the corrupted civil servants. This can explain the "59 year old phenomenon" in China that a lot of civil servants choose to take bribe just before their retirement (In China, government employees retire at the age of 60).

Suppose the corrupted servant will start to take bribe at the last period, the T^{th} year, and then the present value of the expected return is

$$V_{co}^3(T) = p\left[\frac{w_1(1-b_1)}{1+r} + \cdots + \frac{w_{T-1}(1-b_1)}{(1+r)^{T-1}} + \frac{w_T(1-b_1)+G_T}{(1+r)^T}\right] + (1-p)\left[V_{in}(T) + \frac{G_T}{(1+r)^T}\right] \quad (2.36)$$

Just the same as before, under the arrangement of anti-corruption reserving fund system, the government servant will choose to be incorruptible only if he can get a higher expected return when he does not take bribe than he does. In another word, $V_{in}(T) \geq V_{co}^3(T)$ should be satisfied to guarantee the incorruptible behavior of the civil servant.

That is

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decreasing in t no matter $1+r-\gamma(1-p) > 0$ or $1+r-\gamma(1-p) < 0$.

$$w_0(1+b_2)\frac{\gamma\left[1-\left(\frac{\gamma}{1+r}\right)^T\right]}{1+r-\gamma} \geq p\left[\frac{w_1(1-b_1)}{1+r}+\cdots+\frac{w_{T-1}(1-b_1)}{(1+r)^{T-1}}+\frac{w_T(1-b_1)+G_T}{(1+r)^T}\right]+(1-p)\left[w_0(1+b_2)\frac{\gamma\left[1-\left(\frac{\gamma}{1+r}\right)^T\right]}{1+r-\gamma}+\frac{G_T}{(1+r)^T}\right]$$

Rearrange the inequality, we can get

$$b_1+b_2 \geq \frac{G_T(1+r-\gamma)}{pw_0\gamma(1+r)^T\left[1-\left(\frac{\gamma}{1+r}\right)^T\right]}$$

Or

$$b_1+b_2 \geq \frac{G_0{}^{T\alpha}(\gamma-1-r)}{pw_0\gamma\left[\gamma^T-(1+r)^T\right]} \tag{2.37}$$

It is ready to discuss the effect of those parameters such as the promotion (γ) and the corruption return to position (α) to b_1+b_2. First of all, it is clear that b_1+b_2 is increasing in α. Therefore, if b_1 is bounded at $\tilde{b}_1$, in an economic prospective (such that α increases), government has to raise the rate of government subsidy, b_2, in order to efficiently prevent corruption. To consider the relationship between b_1+b_2 and γ. First, take log of the right hand side of the (2.37), we get

$$T\alpha \ln G_0 + \ln(\gamma-1-r) - \ln p - \ln w_0 - \ln\gamma - \ln\left[\gamma^T-(1+r)^T\right]$$

And the derivative w.r.t. γ gives us

$$\text{The Derivative}=\frac{1}{\gamma-1-r}-\frac{1}{\gamma}-\frac{T}{\gamma-(\frac{1+r}{\gamma})^{T-1}}<\frac{1}{\gamma-1-r}-\frac{1}{\gamma}-\frac{T}{\gamma}$$

If $\gamma<\frac{(T+1)(1+r)}{T}$, we will have

$$\frac{1}{\gamma-1-r}-\frac{1}{\gamma}-\frac{T}{\gamma-(\frac{1+r}{\gamma})^{T-1}}<\frac{1}{\gamma-1-r}-\frac{1}{\gamma}-\frac{T}{\gamma}<0$$

Then an increase in the promotion effect γ will make the government

official less willing to corrupt so that the government can reduce the rate of government subsidy b_2 while still keeping the anti-corruption reserving fund system effective. In another word, b_2 and γ are substitutes.

It is also obvious that if w_0 is bigger, the government can lower b_2. In reality, many countries believe that a competitive starting wage w_0, or (and) a high speed of the increase of the wage can effectively reduce corruption. For example, Singapore is famous for using its high wage of the government officials to prevent corruption. From 1970 to 1980, the government increased 20% of their wages 4 times in succession such that since 1989, the wage of the government officials in Singapore has been ranked one of the top tiers of the countries in the world. The wage of the minister-level civil servants has been referred to the wage levels of six specific professions as bankers, accountants, engineers, lawyers, corporation representatives, and manufacturing industry representatives. Meanwhile, the government will hire the consultant agency to investigate the wage level of the private owned enterprises to make sure that there is no great wage difference. In 2000, the monthly wage of the ministers in Singapore is about 48,400 Singapore dollars and the yearly income will be more than 1,000,000 Singapore dollars plus bonus; the monthly wage of general director is about 20,000 dollars and yearly income will be about 400,000 dollars; and just for an ordinary government official, his yearly income will be around 80000 dollars.[13] In Hong Kong, the wage of the government officials is also comparable with Singapore's. The rationale provided in this model reveals that it is because under such circumstances, the government servants are more willing to survive in the public system rather than taking

[13] XINHUA News Agency. http://www.nmg.xinhuanet.com/xwzx/2004-02/06/content_1584667.htm

bribe and jeopardizing his prospects in the government.

3 CONCLUSION AND SUGGESTIONS

3.1 Conclusion

The anti-corruption reserving fund is a practical application of incentive payment. It can ensure the potential fine to be collected from the monthly income of government officials so that it is a much better way to guarantee the enforcement of the economic punishment than simply a one-time economic punishment. From the above analysis in the paper, we can get the following conclusions.

1. The anti-corruption reserving fund can actually be divided into two parts. One is $b_1 w$, and the other is $b_2 w$. $b_1 w$ is a portion of his income that is taken away as part of the accumulation fund. If the servant is detected of corruption, he will not be able to get the money. Therefore, $b_1 w$ can be regarded as a punishment to the corrupted government servants. $b_2 w$ is the subsidy of the government to the official in order to prevent corruption. If the government servant is incorruptible, he can get the money after his retirement, so it can be considered as a reward to the incorruptible government servants.

2. The necessary and sufficient condition for the existence of the government reward in the anti-corruption reserving fund system is $0 \le p \le p^{SU}$ and the necessary and sufficient condition for the existence of the anti-corruption

reserving fund system is $0 \le p \le p^N$. More specifically, when $0 \le p \le p^{SU}$, the anti-corruption reserving fund system will be composed of economic penalty and economic reward; when $p^{SU} \le p \le p^N$, the anti-corruption reserving fund system will only have the economic penalty; when $p^N \le p \le 1$, there is no need of economic penalty or reward to prevent corruption, that is, only the high supervision level will be able to prevent corruption.

Intuitively, supervision is the basic approach in preventing corruption and the supervision level of the nation will determine different ways to fight against bribery. If the supervision level of detecting corruption in a country is very high, there will be no need of the existence of the anti-corruption reserving fund system. However, if the supervision of the corruption in a country is poor, the anti-corruption reserving fund system will be a decent supplementary arrangement to prevent bribery.

3. Under the anti-corruption reserving fund system, the risk-neutral government servant will choose to be incorruptible only if he can get a higher expected return when he does not take bribe than he does. That is, the equation (2.7) should be satisfied to guarantee the incorruptible behavior of the servant when anti-corruption reserving fund system is carried out.

$$\frac{w(1+b_2)}{r} \ge \frac{G + w(1-b_1)}{r+p} \tag{2.7}$$

In the simple dynamic case, equation (2.36) should be satisfied to guarantee the incorruptible behavior of the civil servant if he chooses to take bribe only in the last period under the anti-corruption reserving fund system.

$$b_1 + b_2 \geq \frac{G_0{}^{T\alpha}(\gamma - 1 - r)}{pw_0\gamma\left[\gamma^T - (1+r)^T\right]} \tag{2.37}$$

4. There are two kinds of cost for the government associated with the anti-corruption approaches. The first one is the cost of the supervision effort, that is, $C_1 = C_1(p)$ where $C_1'(p) > 0, C_1''(p) > 0$. The other is C_2, the economic cost for the government, $C_2 = C_2(\tilde{b}_2 w) = w\frac{rG - rw\tilde{b}_1 - wp}{wr(r+p)} = \frac{rG - rw\tilde{b}_1 - wp}{r(r+p)} = C_2(p)$ where $C_1'(\tilde{b}_2 w) > 0$ and $\tilde{b}_2 = f(\tilde{b}_1)$, $f'(b_1) < 0$. A rational government will choose a balance of the supervision level and the economic subsidy so as to minimize the associated cost of these two anti-corruption approaches.

That is

$$\underset{p}{Min}\left(C_1(p) + C_2(p)\right) \tag{2.14}$$

If the first order condition exists, i.e., we can find a p^* such that

$$C_1'(p^*) + C_2'(p^*) = 0$$

(2.15)

Then $p^*(w, r, G, \tilde{b}_1)$ is the optimal p that minimizes the total cost of the anti-corruption reserving fund system. There will be two kinds of equilibrium because of different total cost curve. The first one is that the government will provide a subsidy to the incorruptible civil servants. The other is that the

government will not provide a subsidy because pure supervision will have a lower cost than combined supervision and government subsidy.

5. As to the effect of the corruption return to position (α) to $b_1 + b_2$, it is clear that $b_1 + b_2$ is increasing in α. Therefore, if b_1 is bounded at $\tilde{b}_1$, in an economic prospective (such that α increases), government has to raise the rate of government subsidy, b_2, in order to efficiently prevent corruption. To consider the relationship between the promotion (γ) and $b_1 + b_2$, we can see that an increase in the promotion effect γ will make the government official less willing to commit corruption so that the government can reduce the rate of government subsidy b_2 while still keeping the anti-corruption reserving fund system effective. In another word, b_2 and γ are substitutes. Finally, it is also obvious that if w_0 is bigger, the government can lower b_2.

3.2 Related Policy Suggestions

China has just started to use the anti-corruption reserving fund system to prevent corruption. A lot of detailed corresponding policies are waiting to be revised and improved. However, the anti-corruption reserving fund system can increase the cost for civil servants to take bribe and encourage them to be incorruptible. It is a meaningful trial of government operation. The paper shows the mechanism for the effectiveness of the anti-corruption reserving fund system and its corresponding conditions. From the above analysis, we can propose the following related policy suggestions.

1. The anti-corruption reserving fund is consisted of part of the civil servant's salary, b_1 and the subsidy from the government, b_2. b_1 and b_2 should not be same for all the government servants. We need to have different b_1 and b_2 for different official ranks, salaries and working years. What is most important, b_1 should be higher for civil servants with much higher official ranking. This will prevent the equalitarianism and guarantee the effectiveness of the anti-corruption reserving system for different official ranking.

2. The anti-corruption reserving fund can be associated with retirement pension, Medicare fund and employment insurance fund. The salary of the civil servants is relatively low in China, so the amount of the anti-corruption reserving fund for the government servant is quite limited for preventing corruption effectively. Because b_1 can't be increased to a sufficient high level, we can relate the anti-corruption reserving fund with the retirement pension and some other kind of income. This will result in almost the same outcome as increasing the value of b_1. If the anti-corruption reserving fund is generous enough for the civil servants to lead a decent life after retirement, they will not take bribe easily and take the opportunity cost of being caught and lose this huge amount of money.

3. Part of the anti-corruption reserving fund is from the government, so the country should set a special account in order to pay for the reserving fund. It is

important to find the suitable value for b_2. The lowest b_2 that can keep the effectiveness of the anti-corruption reserving fund is the best choice for the government. The anti-corruption reserving fund system can be carried out step by step if it doesn't bring a huge fiscal burden to the government. In fact, by using the anti-corruption reserving fund system, there will be less civil servants taking bribe. The subsidy to the incorruptible civil servants given by the government is just part of the loss of the government without the anti-corruption reserving fund system. In this way, the government can minimize its loss and get a lower level of corruption at the same time.

4. $b_1 w$ is the punishment to the corrupted government servants and $b_2 w$ is the subsidy of the government to the incorruptible government servants. The combination of punishment and reward is an effective way to stop officials from taking bribe. How much is the punishment relating to the reward should be confirmed according to specific conditions in different areas in China. Also, the extent of corruption and supervision intensity in different parts of China is essential for the comparative value of b_1 and b_2.

5. The anti-corruption reserving fund is just an associated approach to prevent corruption. It is determined by the supervision level of a country. For different supervision level, there will be quite different ways to prevent corruption. Therefore, supervision intensity is the key point in fighting against corruption.

Because the amount of the anti-corruption reserving fund is limited, only rely on the reserving fund system to prevent corruption will not be a good idea. We should manage to increase the efficiency of the government structure and the effectiveness of the legal system to raise the supervision level p.

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APPENDIX: 2006 CORRUPTION PERCEPTIONS INDEX AND ADDITIONAL BACKGROUND DATA

For information on data and methodology please consult the press release and the framework document at www.transparency.org or www.ICGG.ORG

Country Rank	Country	2006 CPI Score	Surveys Used	Standard Deviation	High-Low Range	Confidence range
1	Finland	9.6	7	0.2	9.2 - 9.8	9.4 - 9.7
1	Iceland	9.6	6	0.2	9.2 - 9.8	9.5 - 9.7
1	New Zealand	9.6	7	0.2	9.2 - 9.7	9.4 - 9.6
4	Denmark	9.5	7	0.2	9.2 - 9.7	9.4 - 9.6
5	**Singapore**	**9.4**	**9**	**0.2**	**8.9 - 9.7**	**9.2 - 9.5**
6	Sweden	9.2	7	0.2	8.8 - 9.4	9.0 - 9.3
7	Switzerland	9.1	7	0.3	8.6 - 9.4	8.9 - 9.2
8	Norway	8.8	7	0.6	7.7 - 9.3	8.4 - 9.1
9	Australia	8.7	8	0.7	7.7 - 9.4	8.3 - 9.0
9	Netherlands	8.7	7	0.5	7.7 - 9.3	8.3 - 9.0
11	Austria	8.6	7	0.6	7.7 - 9.2	8.2 - 8.9
11	Luxembourg	8.6	6	0.7	7.7 - 9.7	8.1 - 9.0
11	United Kingdom	8.6	7	0.6	7.7 - 9.2	8.2 - 8.9
14	Canada	8.5	7	0.7	7.6 - 9.3	8.0 - 8.9
15	**Hong Kong**	**8.3**	**9**	**1.0**	**6.7 - 9.3**	**7.7 - 8.8**
16	Germany	8.0	7	0.5	7.5 - 9.1	7.8 - 8.4
17	Japan	7.6	9	1.0	5.4 - 8.9	7.0 - 8.1
18	France	7.4	7	0.9	5.5 - 8.5	6.7 - 7.8
18	Ireland	7.4	7	0.9	5.5 - 8.4	6.7 - 7.9
20	Belgium	7.3	7	1.0	5.5 - 8.9	6.6 - 7.9
20	Chile	7.3	7	0.8	5.5 - 7.7	6.6 - 7.6
20	USA	7.3	8	1.1	5.1 - 8.6	6.6 - 7.8
23	Spain	6.8	7	0.8	5.5 - 7.7	6.3 - 7.2
24	Barbados	6.7	4	0.8	5.8 - 7.7	6.0 - 7.2
24	Estonia	6.7	8	1.1	5.4 - 8.9	6.1 - 7.4
26	Macao	6.6	3	1.2	5.4 - 7.7	5.4 - 7.1
26	Portugal	6.6	7	1.2	5.1 - 7.7	5.9 - 7.3
28	Malta	6.4	4	1.7	5.0 - 8.9	5.4 - 7.3
28	Slovenia	6.4	8	1.2	4.9 - 8.0	5.7 - 7.0

Country Rank	Country	2006 CPI Score	Surveys Used	Standard Deviation	High-Low Range	Confidence range
28	Uruguay	6.4	5	0.8	5.7 - 7.7	5.9 - 7.0
31	United Arab Emirates	6.2	5	0.9	5.4 - 7.6	5.6 - 6.9
32	Bhutan	6.0	3	1.9	4.1 - 8.0	4.1 - 7.3
32	Qatar	6.0	5	0.7	5.4 - 7.0	5.6 - 6.5
34	Israel	5.9	7	1.1	4.1 - 7.6	5.2 - 6.5
34	Taiwan	5.9	9	0.5	5.2 - 6.6	5.6 - 6.2
36	Bahrain	5.7	5	0.7	4.9 - 6.7	5.3 - 6.2
37	Botswana	5.6	6	1.4	4.1 - 7.7	4.8 - 6.6
37	Cyprus	5.6	4	0.5	5.1 - 6.1	5.2 - 5.9
39	Oman	5.4	3	1.3	4.1 - 6.7	4.1 - 6.2
40	Jordan	5.3	7	1.0	3.2 - 6.2	4.5 - 5.7
41	Hungary	5.2	8	0.4	4.6 - 5.8	5.0 - 5.4
42	Mauritius	5.1	5	1.7	3.6 - 7.7	4.1 - 6.3
42	South Korea	5.1	9	0.8	4.0 - 6.0	4.7 - 5.5
44	Malaysia	5.0	9	1.0	3.5 - 6.6	4.5 - 5.5
45	Italy	4.9	7	0.9	4.0 - 6.1	4.4 - 5.4
46	Czech Republic	4.8	8	0.7	4.0 - 5.8	4.4 - 5.2
46	Kuwait	4.8	5	1.0	3.2 - 5.8	4.0 - 5.4
46	Lithuania	4.8	6	1.1	3.4 - 6.7	4.2 - 5.6
49	Latvia	4.7	6	1.1	3.6 - 6.7	4.0 - 5.5
49	Slovakia	4.7	8	0.8	3.6 - 5.8	4.3 - 5.2
51	South Africa	4.6	8	0.9	3.2 - 6.2	4.1 - 5.1
51	Tunisia	4.6	5	1.2	3.5 - 6.7	3.9 - 5.6
53	Dominica	4.5	3	1.2	3.5 - 5.8	3.5 - 5.3
54	Greece	4.4	7	0.9	3.6 - 5.8	3.9 - 5.0
55	Costa Rica	4.1	5	1.0	3.2 - 5.4	3.3 - 4.8
55	Namibia	4.1	6	1.0	3.4 - 6.1	3.6 - 4.9
57	Bulgaria	4.0	7	1.2	2.7 - 6.0	3.4 - 4.8
57	El Salvador	4.0	5	1.1	2.6 - 5.5	3.2 - 4.8
59	Colombia	3.9	7	1.0	3.2 - 5.9	3.5 - 4.7
60	Turkey	3.8	7	0.8	2.3 - 4.9	3.3 - 4.2
61	Jamaica	3.7	5	0.4	3.2 - 4.1	3.4 - 4.0
61	Poland	3.7	8	1.0	2.8 - 5.8	3.2 - 4.4
63	Lebanon	3.6	3	0.4	3.2 - 4.0	3.2 - 3.8
63	Seychelles	3.6	3	0.4	3.2 - 4.0	3.2 - 3.8
63	Thailand	3.6	9	0.7	2.4 - 4.6	3.2 - 3.9
66	Belize	3.5	3	1.0	2.3 - 4.1	2.3 - 4.0
66	Cuba	3.5	3	1.8	1.8 - 5.4	1.8 - 4.7

Country Rank	Country	2006 CPI Score	Surveys Used	Standard Deviation	High-Low Range	Confidence range
66	Grenada	3.5	3	1.1	2.3 - 4.1	2.3 - 4.1
69	Croatia	3.4	7	0.5	2.7 - 4.1	3.1 - 3.7
70	**Brazil**	**3.3**	**7**	**0.4**	**2.7 - 3.9**	**3.1 - 3.6**
70	**China**	**3.3**	**9**	**0.5**	**2.2 - 4.2**	**3.0 - 3.6**
70	Egypt	3.3	6	0.5	2.6 - 4.0	3.0 - 3.7
70	Ghana	3.3	6	0.5	2.6 - 4.0	3.0 - 3.6
70	**India**	**3.3**	**10**	**0.5**	**2.7 - 4.3**	**3.1 - 3.6**
70	Mexico	3.3	7	0.3	2.7 - 3.5	3.1 - 3.4
70	Peru	3.3	5	0.7	2.6 - 4.1	2.8 - 3.8
70	Saudi Arabia	3.3	3	1.0	2.2 - 4.1	2.2 - 3.7
70	Senegal	3.3	5	0.6	2.7 - 4.1	2.8 - 3.7
79	Burkina Faso	3.2	5	0.6	2.7 - 4.1	2.8 - 3.6
79	Lesotho	3.2	5	0.5	2.6 - 4.0	2.9 - 3.6
79	Moldova	3.2	7	0.9	2.3 - 4.5	2.7 - 3.8
79	Morocco	3.2	6	0.6	2.2 - 4.0	2.8 - 3.5
79	Trinidad and Tobago	3.2	5	0.6	2.6 - 4.0	2.8 - 3.6
84	Algeria	3.1	5	0.7	2.3 - 4.1	2.7 - 3.6
84	Madagascar	3.1	5	1.0	2.1 - 4.1	2.3 - 3.7
84	Mauritania	3.1	4	1.1	2.0 - 4.1	2.1 - 3.7
84	Panama	3.1	5	0.4	2.6 - 3.5	2.8 - 3.3
84	Romania	3.1	8	0.3	2.7 - 3.5	3.0 - 3.2
84	Sri Lanka	3.1	6	0.6	2.3 - 4.0	2.7 - 3.5
90	Gabon	3.0	4	0.6	2.2 - 3.5	2.4 - 3.3
90	Serbia	3.0	7	0.6	2.3 - 4.0	2.7 - 3.3
90	Suriname	3.0	4	0.4	2.6 - 3.5	2.7 - 3.3
93	Argentina	2.9	7	0.4	2.4 - 3.5	2.7 - 3.2
93	Armenia	2.9	6	0.3	2.5 - 3.2	2.7 - 3.0
93	Bosnia and Herzegovina	2.9	6	0.3	2.7 - 3.2	2.7 - 3.1
93	Eritrea	2.9	3	1.1	2.2 - 4.1	2.2 - 3.5
93	Syria	2.9	3	0.5	2.3 - 3.2	2.3 - 3.2
93	Tanzania	2.9	7	0.4	2.4 - 3.5	2.7 - 3.1
99	Dominican Republic	2.8	5	0.6	2.1 - 3.5	2.4 - 3.2
99	Georgia	2.8	6	0.4	2.2 - 3.2	2.5 - 3.0
99	Mali	2.8	7	0.7	2.2 - 4.0	2.5 - 3.3
99	Mongolia	2.8	5	0.8	2.2 - 4.1	2.3 - 3.4
99	Mozambique	2.8	7	0.4	2.1 - 3.5	2.5 - 3.0
99	Ukraine	2.8	6	0.4	2.3 - 3.4	2.5 - 3.0

Country Rank	Country	2006 CPI Score	Surveys Used	Standard Deviation	High-Low Range	Confidence range
105	Bolivia	2.7	6	0.4	2.2 - 3.5	2.4 - 3.0
105	Iran	2.7	3	0.5	2.3 - 3.2	2.3 - 3.1
105	Libya	2.7	3	0.5	2.3 - 3.2	2.4 - 3.2
105	Macedonia	2.7	6	0.3	2.3 - 3.2	2.6 - 2.9
105	Malawi	2.7	7	0.5	2.2 - 3.5	2.5 - 3.0
105	Uganda	2.7	7	0.5	2.1 - 3.5	2.4 - 3.0
111	Albania	2.6	5	0.3	2.2 - 2.8	2.4 - 2.7
111	Guatemala	2.6	5	0.5	2.2 - 3.5	2.3 - 3.0
111	Kazakhstan	2.6	6	0.4	2.1 - 3.2	2.3 - 2.8
111	Laos	2.6	4	1.0	1.9 - 4.0	2.0 - 3.1
111	Nicaragua	2.6	6	0.4	2.2 - 3.2	2.4 - 2.9
111	Paraguay	2.6	5	0.8	2.2 - 4.0	2.2 - 3.3
111	Timor-Leste	2.6	3	0.6	2.1 - 3.2	2.3 - 3.0
111	Viet Nam	2.6	8	0.4	1.9 - 3.5	2.4 - 2.9
111	Yemen	2.6	4	0.2	2.3 - 2.7	2.4 - 2.7
111	Zambia	2.6	6	0.7	1.6 - 3.5	2.1 - 3.0
121	Benin	2.5	6	0.6	1.8 - 3.2	2.1 - 2.9
121	Gambia	2.5	6	0.4	1.9 - 3.2	2.3 - 2.8
121	Guyana	2.5	5	0.3	2.0 - 2.7	2.2 - 2.6
121	Honduras	2.5	6	0.3	2.2 - 3.0	2.4 - 2.7
121	Nepal	2.5	5	0.4	2.2 - 3.2	2.3 - 2.9
121	Philippines	2.5	9	0.4	1.9 - 3.5	2.3 - 2.8
121	**Russia**	**2.5**	**8**	**0.4**	**1.9 - 3.2**	**2.3 - 2.7**
121	Rwanda	2.5	3	0.2	2.3 - 2.7	2.3 - 2.6
121	Swaziland	2.5	3	0.3	2.2 - 2.7	2.2 - 2.7
130	Azerbaijan	2.4	7	0.3	2.2 - 3.1	2.2 - 2.6
130	Burundi	2.4	5	0.3	2.1 - 2.7	2.2 - 2.6
130	Central African Republic	2.4	3	0.3	2.2 - 2.7	2.2 - 2.5
130	Ethiopia	2.4	7	0.4	1.8 - 2.8	2.2 - 2.6
130	Indonesia	2.4	10	0.4	1.8 - 3.2	2.2 - 2.6
130	Papua New Guinea	2.4	4	0.2	2.2 - 2.7	2.3 - 2.6
130	Togo	2.4	3	0.4	1.9 - 2.7	1.9 - 2.6
130	Zimbabwe	2.4	7	0.6	1.6 - 3.2	2.0 - 2.8
138	Cameroon	2.3	7	0.3	1.8 - 2.7	2.1 - 2.5
138	Ecuador	2.3	5	0.2	2.0 - 2.6	2.2 - 2.5
138	Niger	2.3	5	0.3	1.8 - 2.7	2.1 - 2.6
138	Venezuela	2.3	7	0.1	2.1 - 2.5	2.2 - 2.4
142	Angola	2.2	5	0.3	1.7 - 2.6	1.9 - 2.4

Country Rank	Country	2006 CPI Score	Surveys Used	Standard Deviation	High-Low Range	Confidence range
142	Congo, Republic	2.2	4	0.0	2.2 - 2.3	2.2 - 2.3
142	Kenya	2.2	7	0.4	1.5 - 2.7	2.0 - 2.4
142	Kyrgyzstan	2.2	6	0.5	1.7 - 3.2	2.0 - 2.6
142	Nigeria	2.2	7	0.3	1.8 - 2.7	2.0 - 2.3
142	Pakistan	2.2	6	0.3	1.6 - 2.6	2.0 - 2.4
142	Sierra Leone	2.2	3	0.1	2.2 - 2.3	2.2 - 2.3
142	Tajikistan	2.2	6	0.3	1.9 - 2.7	2.0 - 2.4
142	Turkmenistan	2.2	4	0.4	1.7 - 2.7	1.9 - 2.5
151	Belarus	2.1	4	0.2	1.8 - 2.3	1.9 - 2.2
151	Cambodia	2.1	6	0.4	1.6 - 2.6	1.9 - 2.4
151	Côte d'Ivoire	2.1	4	0.2	1.9 - 2.3	2.0 - 2.2
151	Equatorial Guinea	2.1	3	0.3	1.7 - 2.3	1.7 - 2.2
151	Uzbekistan	2.1	5	0.3	1.6 - 2.3	1.8 - 2.2
156	Bangladesh	2.0	6	0.4	1.4 - 2.3	1.7 - 2.2
156	Chad	2.0	6	0.4	1.5 - 2.7	1.8 - 2.3
156	Congo, Democratic Republic	2.0	4	0.3	1.7 - 2.3	1.8 - 2.2
156	Sudan	2.0	4	0.2	1.8 - 2.3	1.8 - 2.2
160	Guinea	1.9	3	0.3	1.7 - 2.2	1.7 - 2.1
160	Iraq	1.9	3	0.4	1.6 - 2.3	1.6 - 2.1
160	Myanmar	1.9	3	0.3	1.7 - 2.3	1.8 - 2.3
163	Haiti	1.8	3	0.1	1.7 - 1.9	1.7 - 1.8