The Challenges of Chinese Economic Growth: Inequality and Corruption

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Abstract

This thesis comprises two chapters. My first chapter studies the dynamic of the distribution of wealth using a representative consumer theory with two sources of heterogeneity: taste in public goods and initial wealth. I analyse how the wealthy and the poor change their relative conditions during different economic cycles and apply the theory to a Ramsey growth model to explore distributive predictions.

My second chapter studies the effect of state-owned enterprise, which is one of the most important parts of the economy, on government corruption. I also include several controls to enrich content and analysis. I hope my paper might contribute to the government's efforts to reduce poverty and fight corruption to make a better society.

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Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

Introduction

The economy of China has taken off since reforming and opening its market in the year 1978. After more than thirty years, China has achieved remarkable success in regard not only to the economy but also other aspects of society. However, several social issues have emerged along with economy development. Two major issues that concern Chinese people most are inequality and corruption.

China is believed to be one of the most unequal countries in the world in terms of income. In 2012, the official Gini coefficient in China was 0.474. Since then, the government has stopped reporting the Gini coefficient. According to a report from Peking University in 2014, 1% of the most wealthy population controls one third of total wealth while one fourth of the poorest families occupy less than 1% of total wealth.

China is also one of the most corrupt countries in the world, according to the 2017 Corruption Perceptions Index reported by Transparency International. The Corruption Rank in China averaged 68.70 from 1995 until 2017, reaching an all time high of 100 in 2014 and a record low of 40 in 1995.

Income inequality and corruption have been two of the most concerning social issues of Chinese people. The government puts some effort into trying to solve problems. Xi Jinping has led an anti-corruption campaign since he took office in 2012. The government also came up with a policy to take targeted measures in poverty alleviation in 2014. Some progress has been made, but much more work still needs to be done.

This paper comprises two chapters. My first chapter studies the dynamic of the distribution of wealth using a representative consumer theory with two sources of heterogeneity: taste in public goods and initial wealth. I analyse how the wealthy and the poor change their relative conditions during different economic cycles and apply the theory to a Ramsey growth model to explore distributive predictions.

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Chapter 1

A Representative Consumer Theory of Distribution with Endogenous Labour Supply

Wealth distribution is always a major concern for policy makers since it is directly related to social equality and stabilization. Imbalanced distribution of wealth may cause serious social problems such as increasing the crime rate and poverty within the population. For example, according to the World Bank, 10.7 percent of the world's population lives on less than US$1.90 a day. It is also related to economic growth, "economics is concerned with expanding the pie while politics is about distributing it" (Alesina and Rodick, 1994). Therefore, it is crucial to analyse and understand how the distribution of wealth changes over time so that policy makers are able to choose wisely to redistribute to make society less unequal.

There are plenty of articles addressing this topic. Stiglitz (1969) isolates some economic factors which in the long term tend to equalize wealth and some which tend to make it less evenly distributed. He considers labour skills as the heterogeneity among individ-

uals, which is one of the "forces for inequality". He is the first to attempt to develop a theory of distribution of wealth among individuals instead of among factors of production. His work inspired many later economists, such as Chatterjee (1994). Chatterjee uses a neo-classical growth model to investigate the behaviour of wealth distribution along dynamic paths that converge to the steady state and results show that initial wealth influences the future wealth inequality and the speed of distributional changes. Chatterjee's work differs from Stiglitz's in one important aspect, since he assumes individuals and firms would make rational choices. Becker and Tomes (1986) have also studied the evolution of income distribution in a choice-theoretic framework. They use different kinds of luck among households and examine a number of empirical studies for different countries, discovering that either advantage or disadvantage of ancestors' earnings is wiped out in three generations. Unlike Chatterjee, they do not consider the influence of aggregate dynamics.

The importance of Stiglitz's work is that he introduced heterogeneity among individuals since in real life everyone's behaviour is different. However, it is impossible to track every heterogeneous consumer's distribution in a model; we need another way to study the whole distribution. Therefore Caselli and Ventura (2000) introduce a representative consumer (RC) theory. The definition of a representative consumer is "a fictional consumer whose utility maximization problem when facing aggregate resource constraints generates the economy's aggregate demand function" (Caselli and Ventura, 2000). This assumption is a crucial part of the whole representative consumer growth model since it does not reject the heterogeneous behaviour of each agent in the model but only requires that potential sources of consumer heterogeneity have sufficient structure to ensure that the sum of all consumers behaves as if there were only one consumer. Under this assumption we are able to restrict the behaviour of average quantities to depend exclusively on these same averages. It is also simpler to track these averages than following distribution function. The

RC properties are also held in Alesina and Rodick's (1994) paper as they develop a heterogeneous agents model in which there is absence of policy choice, however they attempt to characterize the link between income distribution and the choice of policies that affect growth.

One important property of the RC theory is that it does not rule out heterogeneity. There are many sources of heterogeneity, including the rates of time preference, tastes, endowments, technology, initial wealth, progressive tax rate and so on. Turnovsky (2015) thinks dispersion of asset endowments across agents is the most important source of heterogeneity. In this chapter, I will choose two sources of consumer heterogeneity: tastes and initial wealth. The reason I choose initial wealth is that Chatterjee (1994) shows that initial condition has a huge effect on the distribution of wealth. If an economy where wealth is distributed more equally among individuals initially, it would have a more equal distribution of wealth in the future. It also influences the rapidity of distributional changes. Initial wealth is always an important factor shaping the dynamic in the distribution of wealth. As for tastes, individuals' preferences in relation to public goods are a crucial factor to generate dynamic in the cross section of consumption. If there are no public goods, then there will be no change in dynamic of relative consumptions, as we show in section 1.2. These two heterogeneities ensure income mobility, in that individuals could improve or worsen their relative position in the cross section part over a given period.

We can also apply the representative consumer assumption to the Ramsey growth model to explore the application of RC theory. We see that the representative consumer theory places few strains on the nature of observed distributions. In this chapter, except endogenous variable consumption c and capital k, I also assume that labour supply l is endogenous. However, it is complicated to study three-dimensional space (k, c, l) therefore I modify the mathematical method (Benhabib and Farmer, 1994) to eliminate the variable l so that I can

analyse only two variables and calculate their steady state. In section 1.4, we first calculate the steady state, then we analyse the transitional dynamics around the steady state. The result shows that even if we assume there is no government, i.e. no public goods, we can still observe the dynamics around a steady state.

This chapter is an extension of work based on Caselli and Ventura (2000). I would like to analyse if an agent in this economy could change their positions in the cross-section of distribution of consumption, labour supply and wealth and how it would change. The difference between my work and Caselli and Ventura's is that I assume labour supply is an endogenous variable instead of an exogenous variable. Labour supply is directly related to labour income, therefore it would also be an important influence upon distribution of wealth. By making labour supply endogenous, I can study how endogenous labour supply would affect the distribution of wealth. It would be helpful to understand how distribution of wealth changes over time so that we could address the problem of inequality more clearly and directly. If we understand this, we could apply the mechanism to the situation in China to help the government to improve inequality rooted in the society. The structure of this chapter is that in the first part of this chapter, I set up the benchmark model and in the following part I create the cross section of consumption, labour supply and wealth, and show how the relative position of the consumer changes. In the last part, I apply my method to the Ramsey growth model and observe the transitional dynamics.

1.1 Model Setup

Let us assume an economy with many infinitely lived agents indexed by $j = 1, 2, 3, \ldots, J$. In this economy, J is large enough that each individual's choice would not affect the aggregate quantities and prices. Every consumer has different taste in goods and they are also different in term of initial wealth.

Let $c_j(t) \in R$ denote individual j's after-tax consumption on private goods and $l_j(t) \in (0, 1)$ denote individual j's labour supply in terms of hours. Suppose that every individual derives utility from consumption and leisure, therefore the utility function of the whole economy is

$$U(c, l) = \int_0^\infty \left[\ln(c_j + \beta_j g) - \psi \ln l_j\right] e^{-\rho t} \tag{1.1}$$

Note that the utility function matches the Gorman polar form which is a functional form for indirect utility functions. It allows researchers to regard a society of utility-maximizers as if it consisted of a single 'representative' individual. Therefore, we can integrate each individual's utility function to form the utility function of the entire economy.

In equation (1.1), $\beta_j \in R_+$ represents different individuals' tastes for the public goods that the government provides, hence $\beta_j g$ can be interpreted as the value of the public goods each consumer receives in terms of the private consumption goods. Note that in this model each individual is no longer identical; the different taste in private and public goods is the first term contributing to consumer heterogeneity. Naturally, if the value of β_j is high, we assume the consumer j prefers public goods more than private goods and vice versa.

Now we consider individuals' wealth in this economy. Each consumer has a different amount of initial assets and they receive return a on their ownership of the assets. They also invest time into labour and receive a salary for their work. These are the two sources of every agent's income and heterogeneity. We define $a_j(t) \in R_+$ to be the stock of financial assets of consumer j. Let $r_j(t) \in R_+$ and $w_j(t) \in R_+$ be the after-tax rate of return on financial assets and the average after-tax wage rate for all consumers. We also define $p \in (0, 1)$ to be the ratio between after-tax private consumption and before-tax private consumption, i.e. $p(t)$ is equal to one minus the proportional consumption tax. With these definitions, now

we can derive the individual's flow budget constraint as

$$\dot{a}_j = ra_j + wl_j - \frac{c_j}{p} \tag{1.2}$$

On the left hand side of equation (1.2), $\dot{a}_j$ denotes the growth of individual j's wealth. On the right hand side, the first term ra_j represents consumer j's return on financial assets; the second term wl_j means individual j's working income and the last term can be interpreted as before-tax consumption. Hence the whole expression can be stated as the increase in financial wealth equal to the excess of income over consumption. Finally, we impose the restriction that no one in this economy can borrow new debt to pay the old debt, i.e. no Ponzi schemes. Now in order to solve the consumer's maximizing problem, we set up the present value Hamiltonian as following

$$H(c, l) = e^{-\rho t}\left[\ln(c_j + \beta_j g) - \psi \ln l_j\right] + \lambda\left(ra_j + wl_j - \frac{c_j}{p}\right) \tag{1.3}$$

Solving for the first order conditions, we obtain

$$\frac{\partial H}{\partial c} = \frac{e^{-\rho t}}{c_j + \beta_j g} - \frac{\lambda}{p} = 0 \tag{1.4}$$

$$\frac{\partial H}{\partial l} = \frac{-\psi e^{-\rho t}}{l_j} + \lambda w = 0 \tag{1.5}$$

$$\frac{\partial H}{\partial a} = \lambda r = -\dot{\lambda} \tag{1.6}$$

We also obtain the transversality condition as following:

$$\lim_{t\to\infty}\left[e^{-\rho t}\lambda(t)a(t)\right] = 0$$

In order to obtain the Euler equation, now we define δ as the growth rate of p and θ as the growth rate of w. Then we have two different Euler equations for consumption and leisure, which are

$$\dot{c_j} = (\delta - \rho + r)\left(c_j + \beta_j g\right) - \beta_j \dot{g} \tag{1.7}$$

$$\dot{l_j} = (r - \theta - \rho) l_j \tag{1.8}$$

We also obtain an intertemporal relationship between consumption and labour supply by substituting λ in equation (1.4) into equation (1.5)

$$\frac{c_j + \beta_j g}{l_j} = \frac{pw}{\psi} \tag{1.9}$$

Now I will check that optimal total consumption is a constant share of household wealth. This is important because it makes aggregation possible so that I can study the dynamic of the cross section of the main aggregated variable. As a preliminary step, we define

$$\int_0^t r(s)ds \equiv R(t)$$

Using an integral factor, we integrate equation (1.2) and (1.7) to obtain

$$c_j(0) + \beta_j g(0) = \varphi\left[a_j(0) + \int_t^\infty \left(wl_j + \frac{\beta_j g}{p}\right) e^{-R(\tau)} d\tau\right] \tag{1.10}$$

where

$$\frac{1}{\varphi} = \int_t^\infty p^{-1} e^{(\delta-\rho)\tau} d\tau$$

The expression states that total consumption, including private and public goods, is equal to a fraction φ of total wealth. Total wealth on the right hand side consists of three parts which are initial assets $a_j(0)$, the net present value of wage income $\int_t^\infty wl_j e^{-R(\tau)} d\tau$ and the

net present value of public goods the individual receives $\int_t^\infty \frac{\beta_j g}{p} e^{-R(\tau)} d\tau$. We do the same integration to equation (1.2) and (1.8), we obtain

$$l_j(0) = \sigma \left[\int_t^\infty \frac{c_j}{p} e^{-R(\tau)} d\tau - a_j(0) \right] \tag{1.11}$$

where

$$\frac{1}{\sigma} = \int_t^\infty w e^{(\rho+\theta)\tau} d\tau$$

We can roughly interpret this expression as the initial wage income is a fraction of consumption minus initial wealth. We can see that both φ and σ are independent of the characteristics of the individuals, thus equation (1.10) and (1.11) are linear in a_j and β_j. This property of consumption and labour supply function, combined with linearity of the flow budget constraint, is essential to allow aggregation in this model.

Now we define an average consumer in this economy with the following characteristics: $a_j = a, l_j = l, \beta_g = 1$. With these definitions, we can rewrite the flow budget constraint, total consumption function and leisure function for an average individual.

$$\dot{a} = ra + wl - \frac{c}{p} \tag{1.12}$$

$$c + g = \varphi \left[a + \int_t^\infty \left(wl + \frac{g}{p} \right) e^{-R(\tau)} d\tau \right] \tag{1.13}$$

$$l = \sigma \left[\int_t^\infty \frac{c}{p} e^{-R(\tau)} d\tau - a \right] \tag{1.14}$$

1.2 Cross Section of Consumption and Labour Supply

We define $c_j^R \equiv \frac{c_j}{c}$ and $l_j^R \equiv \frac{l_j}{l}$ as the cross section of consumption and labour. In this part we first deal with consumption and then we figure out leisure.

Differentiating c_j^R with respect to time and substituting $\dot{c_j}$ with equation (1.7), we obtain the law of motion as follows:

$$\dot{c_j^R} = \left(\beta_j - c_j^R\right) * \frac{g}{c} * [(r + \delta - \rho) - x] \tag{1.15}$$

We integrate equation (1.15), we get

$$c_j^R(t) = c_j^R(0) exp\left[-\int_0^t \frac{g\left[(r + \delta - \rho) - x\right]}{c} d\tau\right] + \beta_j \left[1 - exp\left[-\int_0^t \frac{g\left[(r + \delta - \rho) - x\right]}{c} d\tau\right]\right] \tag{1.16}$$

Note that x is the growth rate of publicly provided goods. Both equation (1.15) and its integral version (2.16) characterize the behaviour of the cross section of consumption. It is stated as a function of average quantities, prices and the distribution of individuals' tastes on public goods. As we can see from these two equations, public goods g generates dynamic in the cross section of consumption. For instance, if we cancel out public goods, i.e. $g = 0$, we obtain the result that $\dot{c_j^R} = 0$ or $c_j^R(t) = c_j^R(0)$. Both results indicate that the cross section of consumption does not change at all.

Firstly, for simplicity, we remove heterogeneity on public goods from the picture and then we study under condition which individuals have different taste in public goods. We control individuals' tastes in public goods to only allow public goods to make the change in order to better understand how the cross section of consumption interacts with public goods. Therefore we let $\beta = 1$ for all the consumers in this economy. Now, whether the individual's consumption converges to the average consumption or diverges only depends on low or high growth in the provision of public goods, i.e. the comparison of $r + \delta - \rho$ and x.

As we set each individual's taste in public goods identical, every consumer now chooses the same positive growth rate for their total consumption $(c_j + \beta_j g)$, i.e. $r + \delta - \rho$. This

growth rate can be derived from equation (1.7) and it is a weighted average of the growth rate of its two components which are private goods and public goods. Note that the growth rate of public consumption is the same for all individuals. If the growth rate of public consumption is low, then private consumption must be growing at a rate that exceeds that of the total consumption in order to sustain the optimal consumption path. It depends on the share of private consumption in total consumption. For example, if a consumer is poor, he or she tends to consume a lower share of private goods, thus a higher growth rate of private consumption is required to sustain the optimal consumption path. This is why a poor consumer improves their relative position in the cross section when an economy grows with low growth in the provision of public goods, i.e.$r + \delta - \rho > x$.

Note that we defined δ as the growth rate of p previously, also p is the ratio of after-tax private consumption and before-tax private consumption, so we can associate δ with consumption tax. The relation between p and consumption tax is negative, thus when δ is high, the consumption tax falls rapidly. In this case, total consumption grows quickly. Since all consumers' consumption of public goods grows at the same rate (x), the private consumption of relatively poor individuals must grow especially fast in order to sustain the optimal path.

Now with these two examples, we can conclude that whether or not an individual exhibits a growth rate of consumption above the average or not depends on his or her share of private consumption in total consumption. We reintroduce taste in public goods as heterogeneity ($\beta \neq 1$); a rich consumer who places a high value on public goods could still have a low share of private consumption, while a poor individual could have a high share if he or she does not highly value public goods. If two agents have the same ratio c_j/β_j, they will have the same share. This means that if the economy expands with low growth in the provision of public goods ($r + \delta - \rho > x$), individuals with a low ratio c_j/β_j tend to

improve their position in the cross section consumption and if the economy expands with high growth in the provision of public goods ($r + \delta - \rho < x$), individuals with a low ratio c_j/β_j tend to worsen their position in the cross section consumption.

Differentiating l_j^R with respect to time and substituting $\dot{l}_j$ with equation (1.8), we obtain the law of motion as follows:

$$\dot{l_j^R} = (r - \rho - \theta)(1 - l_j^R) \tag{1.17}$$

We integrate equation (1.17), we get

$$l_j^R(t) = l_j^R(0) exp\left[- \int_0^t (r - \rho - \theta)\, d\tau \right] \tag{1.18}$$

Both equation (1.17) and its integral version (1.18) characterize the behaviour of the cross section of labour supply. We can easily see that if $\rho + \theta = r$, then $\dot{l_j^R} = 0$ and $l_j^R(t) = l_j^R(0)$. Both results indicate that the cross section of labour supply does not change at all.

Consumers obtain wealth from two parts: return on financial assets and wage income. Individuals must earn enough to satisfy the optimal consumption path and wealth accumulation path. For instance, if an agent is poor, he or she tends to possess less initial wealth thus more time should be spent on working in order to sustain an optimal consumption path. Note that θ is the growth rate of wage and r is the interest rate, if interest rate is high enough that exceeds wage increase ($r > \rho + \theta$), then individuals with high financial assets tend to work less while poor individuals need to work more time to earn enough to sustain optimal growth path thus they tend to worsen their position in the cross section of labour supply.

1.3 Cross Section of Wealth

We define $a_j^R \equiv \frac{a_j}{a}$ as the cross section of wealth. Differentiating a_j^R with respect to time, we have the law of motion:

$$\dot{a_j^R} = \frac{w}{a}\left(l_j - l * a_j^R\right) - \frac{1}{ap}\left(c_j - c * a_j^R\right) \tag{1.19}$$

We combine equation (1.19) with equation (1.10) and (1.13), we get the final expression for a_j^R as follows:

$$\dot{a_j^R} = X_l\left(l_j - l * a_j^R\right) + X_\beta\left(\beta_j - a_j^R\right) \tag{1.20}$$

where

$$X_l = \frac{w}{a} - \frac{\varphi}{ap}\int_t^\infty we^{-R(\tau)}d\tau, X_\beta = \frac{g}{ap} - \frac{\varphi}{ap}\int_t^\infty \frac{g}{p}e^{-R(\tau)}d\tau$$

If we normalize β to one, then we can interpret X_l as a function that captures the net savings out of labour income (as a share of the average consumer's financial assets since it is divided by a) and X_β also as a function that measures the net saving (as a share of the average consumer's financial assets as well) out of public goods. If we take the reverse of these two functions, we can clearly see that both two functions state the difference between the net present values of future wages and public goods and current wages and current public consumption. Therefore, $-X_l$ and $-X_\beta$ can be interpreted as how fast labour income and public consumption grows.

Now we integrate equation (1.20), so that we have their integral form like

$$\begin{aligned} a_j^R(t) = a_j^R(0) exp\left[-\int_0^t \left(X_l l + X_\beta\right) d\tau\right] + \\ l_j \int_0^t X_l exp\left[\int_\tau^t \left(X_l l + X_\beta\right) ds\right] d\tau + \\ \beta_j \int_0^t X_\beta exp\left[\int_\tau^t \left(X_l l + X_\beta\right) ds\right] d\tau \end{aligned} \tag{1.21}$$

Both equation (1.20) and its integral version (1.21) characterize the behaviour of the cross section of wealth. Take equation (1.21) for example, we can see that it is a function of average quantities and prices and the distribution of the initial cross section of wealth $a_j^R(0)$ and individual j's labour supply l_j and taste in public goods β_j. We can also see that unlike the cross section of consumption, public goods is not the only generator of dynamics, other variables also do so since even we can control $g = 0$, $a_j^R(t) \neq a_j^R(0)$, i.e. there is still dynamic existing in the cross section of wealth.

We write equation (1.20) as follows:

$$\dot{a_j^R} = X_l l\left(l_j^R - a_j^R\right) + X_\beta\left(\beta_j - a_j^R\right) \tag{1.22}$$

If we assume in equation (1.22) that there is no cross-sectional variation in tastes, i.e. $\beta_j = 1$ and all individuals work the same time, then we can analyse this situation similarly to the cross section of consumption. In this economy, individuals first calculate their total wealth (including stock of financial assets and the net present value of labour income and public goods) then they choose the optimal path for total consumption. Due to the property of homothetic preference, all consumers spend the same proportion of total wealth in each date and thus they exhibit identical rates of accumulation of wealth. Note that the growth rate of total wealth is a weighted average value of three parts: the growth rate of the stock of financial assets and the net present value of labour income and public goods. We control

the cross section of labour supply and set taste in public goods equal to one, hence the last two components' growth rate is identical for all agents. If this growth rate is low, then consumers must accumulate their financial assets at a rate that exceeds that of the total wealth. For those who are poor, the share of financial assets in total wealth must be low, thus they require a high growth rate of financial assets to sustain the optimal consumption path. Then, similar to the previous case, when $X_l l + X_\beta > 0$, poor consumers tend to improve their relative position in the cross section of wealth.

Now return to the normal case, we do not control labour supply and β_j which means the share of net present value labour income will be higher if a consumer works more hours and the share of net present value of public goods will be higher if an individual attaches more value to public goods. Then the share of financial assets will be lower in total wealth, therefore the growth rate of financial assets must be higher in order to sustain the optimal consumption path. This is the reason that in an economy with low average growth in labour income and public goods, consumers with low ratios a_j/l_j and a_j^R/β_j tend to improve their relative position in the cross section of wealth.

Now let us see how labour supply choices interact with consumption choices in shaping the dynamic of the cross section of wealth. We rewrite equation (1.19) as follows:

$$\dot{a_j^R} = \frac{wl}{a}\left(l_j^R - a_j^R\right) - \frac{c}{ap}\left(c_j^R - a_j^R\right) \tag{1.23}$$

We integrate equation (1.23) and then we have

$$\begin{aligned} a_j^R(t) = a_j^R(0) exp\left[-\int_0^t \left(\frac{wl}{a} - \frac{c}{ap}\right) d\tau\right] + \\ l_j \int_0^t \frac{w}{a} exp\left[-\int_\tau^t \left(\frac{wl}{a} - \frac{c}{ap}\right) ds\right] d\tau - \\ c_j \int_0^t \frac{1}{ap} exp\left[-\int_\tau^t \left(\frac{wl}{a} - \frac{c}{ap}\right) ds\right] d\tau \end{aligned} \tag{1.24}$$

We can interpret wl/a as the share of the labour income out of financial assets of the average consumer and c/ap as the share of before-tax private consumption out of the financial assets of the average consumer. Intuitively, equation (1.24) shows that initial wealth, labour supply and consumption choice all contribute to shape the dynamic of the cross section of wealth.

1.4 Ramsey Model

1.4.1 Steady State Analysis

To explore the application of representative consumer theory, now we turn to study the distributive properties of the popular Ramsey growth model. We would find that the representative consumer theory property places few restrictions on the nature of observed distributions, so that a wide range of distributive dynamics and income mobility patterns can arise as the equilibrium outcome of the model, depending on different production functions. We can use this property to obtain a more direct insight into the dynamic of distribution of wealth in a representative model. In this part, we choose the Cobb-Douglas production function as an example.

Let us assume a large amount of identical competitive firms indexed by i. Let k and l be the average stock of capital and labour in the economy respectively and A be the technology level. We assume the production function $f(k, Al)$ is homogeneous in k and l and fits Inada conditions.

For simplicity, we assume the government finances itself to provide public goods through consumption tax, thus the revenue obtained from taxation is $c(1 - p)/p$. We define public goods as an increasing function of contemporaneous revenue, i.e. $g = g(c(1-p)/p), g'(c(1-p)/p) \geq 0$. To simplify the calculation later, we suppose that this function is linear in private

consumption c, i.e. $g = \frac{1-p}{p}c$.

We assume the firms take a Cobb–Douglas production function as

$$y = f(k, Al) = Ak^{\alpha}l^{\beta}, \alpha > 0, \beta > 0, \alpha + \beta < 1 \tag{1.25}$$

where k and l are average capital stock and labour supply. Therefore we get

$$rk = k * f_k(k, AL) = A\alpha k^{\alpha}l^{\beta} = \alpha y \tag{1.26}$$

$$wl = l * f_l(k, AL) = A\beta k^{\alpha}l^{\beta} = \beta y \tag{1.27}$$

As with Caselli and Ventura (2000), we assume that individuals' preferences for public goods are unified to one and the proportional consumption tax is constant, i.e $\delta = 0$. We define $z \equiv c + g = c + \frac{1-p}{p}c = \frac{c}{p}$. Therefore we obtain $c = pz$. Then we have the relation based on equation (1.7) and (1.9)

$$\frac{z}{l} = \frac{pw}{\psi} \Rightarrow z = \frac{pwl}{\psi} \Rightarrow l = \frac{z\psi}{pw} \tag{1.28}$$

$$\frac{\dot{z}}{z} = r - \rho \tag{1.29}$$

Note that $a = k$ therefore we can rewrite equation (1.12) as

$$\dot{k} = rk + wl - c/p \tag{1.30}$$

We divide equation (1.30) by k and we get

$$\frac{\dot{k}}{k} = r + \frac{wl}{k} - p^{-1}\frac{c}{k} = \alpha\frac{y}{k} + \beta\frac{y}{k} - p^{-1}\frac{c}{k} = (\alpha + \beta)\frac{y}{k} - p^{-1}\frac{pz}{k} \tag{1.31}$$

We rewrite equation (1.29) by substituting r in equation (1.26) to obtain

$$\frac{\dot{z}}{z} = \alpha\frac{y}{k} - \rho \tag{1.32}$$

Now we take a logarithmic transformation of equation (1.31) and (1.32) to obtain

$$dlogk/dt = (\alpha + \beta)e^{logy/k} - p^{-1}e^{log(pz)/k} \tag{1.33}$$

$$dlogz/dt = \alpha e^{logy/k} - \rho \tag{1.34}$$

In order to obtain an autonomous pair of differential equations, we need to rewrite y/k in terms of k and c (Note that both z and g are functions of c since we assume p is constant). We take a logarithmic transformation of the Cobb-Douglas production function (1.25) and equation (1.28), and we get

$$logy = logA + \alpha logk + \beta logl \tag{1.35}$$

$$logl = logz + log\frac{\psi}{pw} \tag{1.36}$$

We eliminate $logl$ in both equations to obtain $logy/k$, and we get

$$logy/k = \lambda_0 + \lambda_1 logl + \lambda_2 logz \tag{1.37}$$

where

$$\lambda_0 = logA + \beta log\frac{\psi}{pw}, \lambda_1 = \alpha - 1 < 0, \lambda_2 = \beta > 0$$

Therefore we obtain the dynamic system in (k, z) space, as follows:

$$dlogk/dt = (\alpha + \beta)e^{\lambda_0 + \lambda_1 logk + \lambda_2 logz} - p^{-1}e^{log(pz)/k} \tag{1.38}$$

$$dlogz/dt = \alpha e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} - \rho \tag{1.39}$$

An equilibrium path (k, z) is the trajectory that solves equation (1.40) and (1.41) subject to the initial condition $k(0) = k_0$ and to the transversality condition. Now we turn to find the steady state of equation (1.40) and (1.41). We let $dlogk/dt = 0$ and $dlogz/dt = 0$ then we obtain two equations as follows:

$$(\alpha+\beta)e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} - p^{-1}e^{log(pz)/k} = 0, \alpha e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} - \rho = 0$$

We do some simple algebra calculation that yields

$$e^{logz^*} = (\alpha+\beta)\frac{p\rho}{\alpha}e^{-logp}e^{logk^*} \tag{1.40}$$

$$e^{(\lambda_1+\lambda_2)logk^*} = \frac{\rho}{\alpha}\left[(\alpha+\beta)\frac{p\rho}{\alpha}\right]^{-\lambda_2} e^{-(\lambda_0-\lambda_2 logp)} \tag{1.41}$$

Clearly, $p\rho > 0$, then we obtain the solutions for (k^*, z^*) are

$$logk^* = \frac{1}{\lambda_1+\lambda_2}\left[log\frac{\rho}{\alpha} - \lambda_2 log(\alpha+\beta)\frac{p\rho}{\alpha} - \lambda_0 + \lambda_2 logp\right] \tag{1.42}$$

$$logz^* = log(\alpha+\beta)\frac{p\rho}{a} - logp + logk^* \tag{1.43}$$

Therefore, $(logk^*, logz^*)$ is the steady state for the dynamic system in (k, z) space of equation (1.38) and (1.39).

1.4.2 Transitional Dynamic

Since we obtain two nonlinear ordinary differential equations (ODEs) of equation (1.38) and (1.39), we construct the Jacobian matrix to linearize the system and calculate eigenval-

ues. Firstly we define

$$u(k,z) \equiv dlogk/dt = (\alpha+\beta)e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} - p^{-1}e^{log(pz)/k}, v(k,z) \equiv dlogz/dt = \alpha e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} - \rho$$

Then we obtain the Jacobian matrix as follows:

$$J(k,z) = \begin{bmatrix} \frac{\partial u}{\partial k} & \frac{\partial u}{\partial z} \\ \\ \frac{\partial v}{\partial k} & \frac{\partial v}{\partial z} \end{bmatrix}$$

After some simple algebra calculation, we obtain

$$J(k,z) = \begin{bmatrix} \lambda_1(\alpha+\beta)e^{\lambda_0+\lambda_1 logk+\lambda_2(\alpha+\beta)logz} + p^{-1}e^{log(pz)/k} & \lambda_2(\alpha+\beta)e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} - p^{-1}e^{log(pz)/k} \\ \\ \alpha\lambda_1 e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} & \alpha\lambda_2 e^{\lambda_0+\lambda_1 logk+\lambda_2 logz} \end{bmatrix}$$

Now we evaluate the Jacobian matrix at the steady state, and we get

$$f(k^*,z^*) = \begin{bmatrix} (\lambda_1+1)(\alpha+\beta)\frac{\rho}{a} & (\lambda_2-1)(\alpha+\beta)\frac{\rho}{a} \\ \\ \lambda_1\rho & \lambda_2\rho \end{bmatrix}$$

Then the resulting linearised system is

$$dlogk/dt = (\lambda_1+1)(\alpha+\beta)\frac{\rho}{a}(logk - logk^*) + (\lambda_2-1)(\alpha+\beta)\frac{\rho}{a}(logz - logz^*)$$

$$dlogz/dt = \lambda_1\rho(logk - logk^*) + \lambda_2\rho(logz - logz^*)$$

Then we can compute the Jacobian matrix evaluated at the steady state as following

$$trace = (\lambda_1+1)(\alpha+\beta)\frac{\rho}{a} + \lambda_2\rho \tag{1.44}$$

$$det = \frac{\lambda_2(\lambda_1 + 1)(\alpha + \beta)\rho^2}{\alpha} - \frac{\lambda_1(\lambda_2 - 1)(\alpha + \beta)\rho^2}{\alpha} = \frac{(\lambda_1 + \lambda_2)(\alpha + \beta)\rho^2}{\alpha} \tag{1.45}$$

To check if *det* is always negative independently of the choice of the parameters, we substitute λ_1 and λ_2 into equation (1.47), and obtain

$$det = \frac{(\lambda_1 + \lambda_2)(\alpha + \beta)\rho^2}{\alpha} = (\alpha + \beta - 1)(\alpha + \beta)\frac{\rho^2}{\alpha}$$

Note that we assume a decreasing returns to scale production function, i.e. $\alpha + \beta < 1$. Clearly $\frac{\rho^2}{\alpha}$ and $\alpha + \beta$ are positive while term $\alpha + \beta - 1$ is always negative thus we have a determinant which is always negative. Therefore, the equilibrium is unique. Now we define μ as the eigenvalues, then we obtain the characteristic equation as

$$det(\mu I - J(k^*, z^*)) = det\begin{bmatrix} \mu & 0 \\ 0 & \mu \end{bmatrix} - \begin{bmatrix} (\lambda_1 + 1)(\alpha + \beta)\frac{\rho}{\alpha} & (\lambda_2 - 1)(\alpha + \beta)\frac{\rho}{\alpha} \\ \lambda_1\rho & \lambda_2\rho \end{bmatrix} = 0$$

Then we have an equation as follows:

$$\left[\mu - (\lambda_1 + 1)(\alpha + \beta)\frac{\rho}{\alpha}\right][\mu - \lambda_2\rho] - \lambda_1\rho(\alpha + \beta) * (\lambda_2 - 1)\frac{\rho}{\alpha} = 0$$

As $detJ = \mu_1\mu_2$, it will always be the case where one is positive and another is negative. Therefore the steady state is always saddle path stable.

There are several differences between my model and regular Ramsey growth model. First is that I introduce government presence and endogenous labour supply. I make total consumption (z) equal to private consumption and public goods and adapt some mechanisms from Benhabib and Farmer's (1994) to express endogenous labour supply with total consumption (z) to ensure the equilibrium in two dimensional space. Both factors would differ the results in the steady state with regular Ramsey model. We will analyse how the

dynamics change in the steady state in the following examples. Another difference is that I construct Jacobian matrix to linearise ordinary differential equations (ODEs) to make it more simple to analyse the equilibrium. There is one similarity that the equilibrium in both my model and Ramsey growth model is saddle path stable.

Now we take two examples to analyse the dynamic around the steady state. First, we assume there is no government in this model, i.e. $p = 1$. We evaluate $\alpha = \beta = \frac{1}{3}, \rho = \frac{1}{2}$, then we can calculate the steady state as follows

$$f(k^*, z^*) = \begin{bmatrix} \frac{1}{3} & -\frac{2}{3} \\ -\frac{1}{3} & \frac{1}{6} \end{bmatrix}$$

Therefore the characteristic equation is

$$\mu^2 - \frac{1}{2}\mu - \frac{1}{6} = 0$$

After calculation we obtain the two eigenvalues

$$\mu_1 = \frac{\sqrt{3} + \sqrt{11}}{4\sqrt{3}} > 0, \mu_2 = \frac{\sqrt{3} - \sqrt{11}}{4\sqrt{3}} < 0$$

In figure 1.1, two red lines are $\dot{k} = 0$ and $\dot{z} = 0$ respectively and the black line is animated trajectory of the solution path. We see from figure 1.1 that if the economy travels along the stable arm, consumption z would always converge to the steady state since it is saddle path stability. The black line shows one example that the economy starts from initial point that exceeds the steady state, we can see that z declines at first then increases.

Note that we assume there is no government in this example, i.e. $p = 0$. We already know there are no dynamics in the cross section of consumption, however, we can still observe dynamics in the cross section of wealth as it is shown in the figure 1.1.

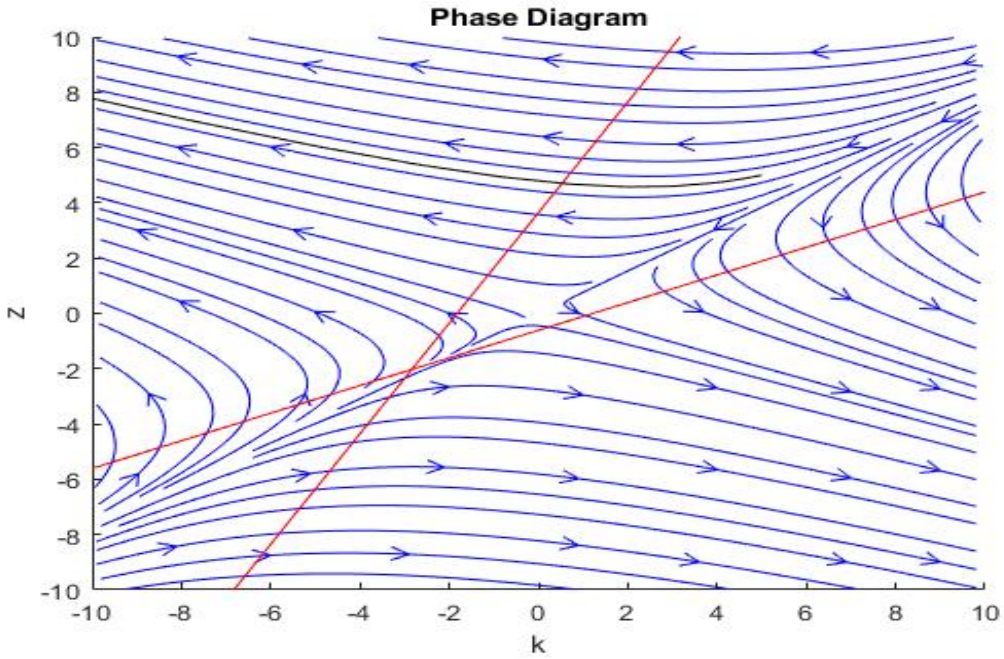

Figure 1.1: Cobb-Douglas production function without government

Now we take an example with the government presence, i.e. $p \neq 1$. We evaluate $\alpha = \frac{1}{2}, \beta = \frac{1}{4}, \rho = \frac{1}{3}, p = \frac{1}{2}$, then we can calculate the steady state as follows

$$f(k^*, z^*) = \begin{bmatrix} \frac{1}{4} & -\frac{3}{8} \\ -\frac{1}{6} & \frac{1}{12} \end{bmatrix}$$

Therefore the characteristic equation is

$$\mu^2 - \frac{1}{3}\mu - \frac{1}{24} = 0$$

After calculation we obtain the two eigenvalues

$$\mu_1 = \frac{\sqrt{2} + \sqrt{5}}{6\sqrt{2}} > 0, \mu_2 = \frac{\sqrt{2} - \sqrt{5}}{6\sqrt{2}} < 0$$

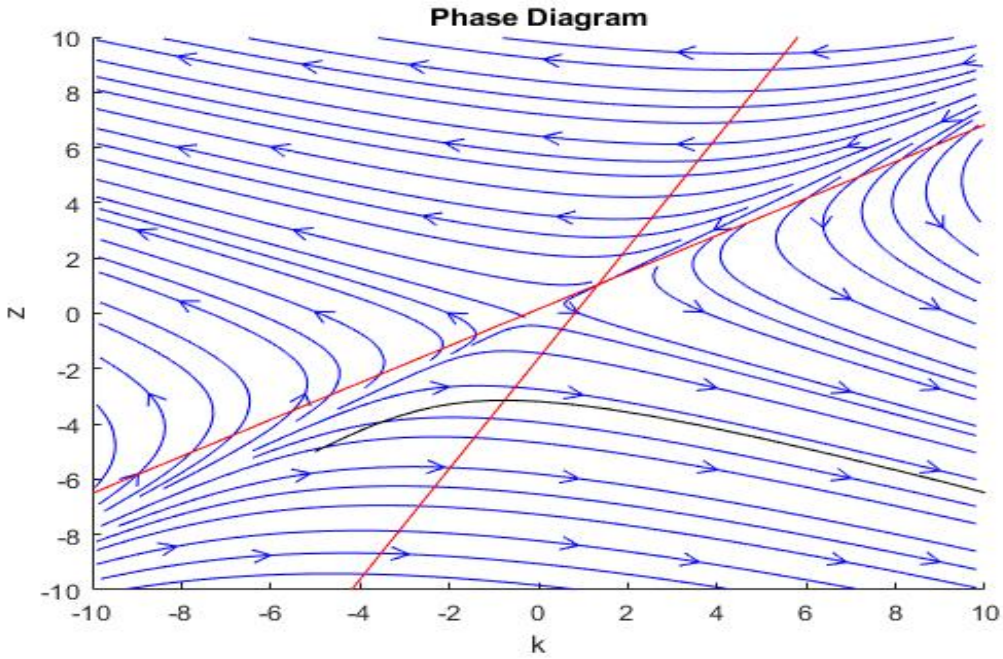

Figure 1.2: Cobb-Douglas production function with government

Figure 1.2 shows the results around the steady state with the government presence. two red lines are $\dot{k} = 0$ and $\dot{z} = 0$ respectively and the black line is animated trajectory of the solution path. It is still a saddle path stability thus if the economy travels along the stable arm, consumption z would always converge to the steady state. The black line shows one example that the economy starts from initial point that is below the steady state, we can see that z increases at the beginning then it declines.

1.5 Conclusion

In this chapter, we have analysed the influence of introducing two sources of heterogeneity in the RC growth model and studied the dynamics in the cross section of consumption, labour supply and wealth. In the cross section of consumption, we draw the conclusion that two consumers would have the same share of public goods in total consumption if and

only if they have the same ratio c_j/β_j. Consumers with a low ratio c_j/β_j tend to improve their position in the cross section of consumption if $r + \delta - \rho > x$. In the cross section of labour supply, we conclude that if the interest rate is high, rich people tend to work less while poor people need to work more to sustain optimal growth path. In the cross section of wealth, we observe that if the growth rate in wages and public goods is low, individuals possessing more initial wealth tend to improve their relative position while the working class tend to worsen. The observations would help policy makers to make to be more helpful to address inequality.

We also apply the RC assumptions to the Ramsey growth model and use the Cobb-Douglas production function. We find that the RC property places few restraints on the dynamics of observed distributions, we set up with two examples to show how dynamic changes around steady state. Another important finding is that even if there are no public goods in the model, we are still able to observe the dynamics around the steady state in the cross section of wealth.

1.6 Appendix

1.6.1 Euler Equation

Let us show how we get the Euler equation for consumption and labour supply. Let equation (1.4) equal to zero and rewrite it, so that we get

$$\frac{p * e^{-\rho t}}{c_j + \beta_j g} = \lambda$$

Then we take a logarithm on both sides and we have

$$logp - \rho t - log\left(c_j + \beta_j g\right) = log\lambda$$

We take a derivative with respect to time, and obtain

$$\frac{\dot{p}}{p} - \rho - \frac{\dot{c_j} + \beta_j \dot{g}}{c_j + \beta_j g} = \frac{\dot{\lambda}}{\lambda} = -r$$

We arrange this to get the Euler equation for consumption as equation (1.7). The same procedure applies to the Euler equation for labour supply, i.e. equation (1.8).

1.6.2 Integral

We rewrite equation (1.2) as follows:

$$\dot{a_j} - r a_j = w l_j - \frac{c_j}{p}$$

We Multiply both sides with integral factor, and get

$$\dot{a_j} exp\left(-\int_0^t r(s)\,ds\right) - r a_j exp\left(-\int_0^t r(s)\,ds\right) = w l_j exp\left(-\int_0^t r(s)\,ds\right) - \frac{c_j}{p} exp\left(-\int_0^t r(s)\,ds\right)$$

Then the LHS can be regarded as differentiating a_j with respect to time, so that we obtain

$$\frac{d}{dt}\left[a_j exp\left(-\int_0^t r(s)\,ds\right)\right] = exp\left(-\int_0^t r(s)\,ds\right)\left(w l_j - \frac{c_j}{p}\right)$$

We take integration on both sides from time zero to time T

$$a_j exp\left(-\int_0^t r(s)\,ds\right)\Big|_0^T = \int_0^T \left[\left(w l_j - \frac{c_j}{p}\right) exp\left(-\int_0^t r(s)\,ds\right)\right] d\tau$$

After some algebra, we have

$$a_j(T)\, exp\left(-\int_0^T r(T)\,dT\right) - a_j(0) = \int_0^T \left[w l_j(t)\, exp\left(-\int_0^t r(s)\,ds\right)\right] d\tau - \int_0^T \left[\frac{c_j(t)}{p} exp\left(-\int_0^t r(s)\,ds\right)\right] d\tau$$

We take the limit as $T \to \infty$ and note that we rule out a Ponzi scheme, we obtain

$$\int_0^{\infty} \left[\frac{c_j(t)}{p} exp\left(- \int_0^t r(s)\, ds \right) \right] d\tau = a_j(0) + \int_0^{\infty} \left[wl_j(t)\, exp\left(- \int_0^t r(s)\, ds \right) \right] d\tau$$

Now we rewrite equation (1.7)

$$\frac{\dot{c_j} + \beta_j \dot{g}}{c_j + \beta_j g} = \delta - \rho + r$$

Let $X(t) = c_j + \beta_j g$ then we get

$$\frac{\dot{X(t)}}{X(t)} = \delta - \rho + r$$

This can be regarded as

$$\frac{d}{dt} \left[logX(t) \right] = \delta - \rho + r$$

We integrate both sides from time zero to time t, so that we have

$$X(t) = X(0)\, exp \left[\int_0^t (r(t) + \delta - \rho)\, ds \right]$$

Therefore, we have

$$c_j(t) = \left[c_j(0) + \beta_j g(0) \right] exp \left[\int_0^t (r(t) + \delta - \rho)\, ds \right] - \beta_j g(t)$$

We substitute this into the previous equation and with some rearranging; we obtain the final integral version, i.e. equation (1.10).

1.6.3 Differential

We derive c_j^R with respect to time, so that we obtain

$$\dot{c_j^R} = \frac{\dot{c_j}}{c} - \frac{c_j \dot{c}}{c^2}$$

We combine this equation with equation (1.7) and its derivation equation of c, so that we can obtain equation (1.15) in the end. The same procedure applies to equation (1.19).

Chapter 2

The Role of State-owned Enterprises on Corruption in China

Corruption has always been a major social problem haunting both developed and developing countries around the world. According to the definition of the World Bank, corruption means "the offering, giving, receiving or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party". Corruption includes acts of bribery, embezzlement, nepotism and state capture. Although it is difficult to estimate the precise cost of corruption, a report accomplished in 2012 by World Economic Forum shows this cost to equals more than 5% of global GDP (US dollar 2.6 trillion)[1]. The overall economic and social costs of corruption are likely to be even larger compared to the said data. It is only rational to fight corruption in order to make government and society more transparency and efficient.

The economy of China has taken off since Deng Xiaoping's reforming and opening market policy, and it has achieved remarkable goals in the last 40 years. China has be-

[1]The report is shown in this website:
http://reports.weforum.org/global-agenda-council-2012/councils/anti-corruption/

come the second largest economy and the largest developing country in the world and it still remains above the average growth rate. However, corruption is becoming more and more intense as the economy develops and China is one of the countries that suffers most from corruption around the world. According to the Transparency International Corruption Perceptions Index 2016[2] , China was the 79 least corrupt nation out of 175 countries. This is a progress compared to 2014 (100th) and 2015 (83th) but still far from satisfactory. The Asian Barometer Survey[3] conducted a survey in mainland China in 2002 including one question: Corruption in politics and government is under control - is better than before? 28% of interviewees chose the answer "somewhat worse", nearly half (46.3%) answered "much worse". This survey shows a trending public opinion in China, i.e. that corruption is much worse since reforming and opening market in 1978. This opinion is particularly popular among senior citizens. They tend to blame Deng Xiaoping's policy for the corruption. Whether this is true or false, people feel dissatisfied about corruption in government in spite of the speeding economic growth.

There are severe consequences resulting from corruption. The first is that corruption is bad for economic growth. This is almost a consensus among economists, and China is no exception. Speeding economic growth in the past three decades has depended largely on demographic dividend and foreign capital. Wang and Mason (2004) argue that demographic dividend contributes 15% to economic growth between 1982 and 2000. With demographic dividend fading away and foreign capital withdrawing investment, the Chinese economy has been in turmoil in the past few years and corruption has re-emerged. Mauro (1995) argues that corruption hurts economic growth by lowering investment. This is consistent with the current situation in China. Private investment has been decreasing in these years

[2]The index is shown in the website:
https://www.transparency.org/news/feature/corruption_perceptions_index_2016

[3]The survey can be found in this website:
http://www.jdsurvey.net/jds/jdsurveyAnalisis.jsp?ES_COL=101&Idioma=I&SeccionCol=04&ESID=447

and hit a record low in 2015. Taking north east China (Heilongjiang, Jilin and Liaoning) for example, these three provinces' governments are notorious for their corruption and black-box operation. The North East is also filled with state-owned enterprises (SOEs). The SOEs compete unfairly with private companies taking advantage of their connection with the government. There is a saying, "Do not invest beyond Shanhaiguan", which means do not invest in North East China. Private investment dropped dramatically in the North East by 27.5% in the first quarter of 2017. The numbers are 9.5% and 26% in 2015 and 2016 respectively. The GDP growth rate is relatively low in North East China compared to other areas.

The second disadvantage is that corruption hurts the image of government, resulting in citizens losing faith in the government. Although polls show that Chinese citizens are more satisfied with the government than western countries, this is far from the whole truth. The Chinese government controls speech and press tightly, therefore the media tends to report positive news of the government instead of criticizing. In the less controlled internet, people are more likely to complain about corruption and discredit the government. When the government denies rumours, people tend to believe rumours instead of the government. The government is consequently losing its credibility. Roman historian Tacitus said once "and now that the emperor was once hated, his good and evil deeds alike brought him unpopularity". The government seems to be the "hated emperor" and this is a vicious circle.

Corruption also harms social justice and welfare. For example, state-owned enterprises could take advantage of monopoly benefits to provide their employees with products at a lower price than average citizens and pass on the high production cost to the whole society. This happens quite often among monopoly state-owned enterprises.

Therefore, Xi Jinping has been fighting corruption harder under his administration and

some progress has been made. He is leading an anti-corruption campaign in China and it has been gaining prominence in recent years. Dozens of high-ranked officials have been arrested and convicted. However, more work needs to be done. The government system still remains unchanged and the legal system has not improved substantially. Depending on the rule of man instead of the rule of law is considered to be temporary, thus corruption is still a severe social problem in China.

State-owned enterprises (SOEs) play a special role in the Chinese economy and contribute substantially to the economic take-off. However, public opinion tends to think that state-owned enterprises induce corruption and argues that the most corrupted areas are those depending more deeply on state-owned enterprises. A research[4] conducted in 2012 by The People's Forum shows that 61.9% interviewees express negative feelings towards state-owned enterprises mainly because they are concerned about the corruption and monopoly of state-owned enterprises. This chapter provides empirical evidence on the role of state-owned enterprises on corruption in mainland China. I use the share of SOE employees as a percentage of total workers in each province over 1998-2016 as an indicator of the prominence of state-owned enterprises.

There are papers addressing the relationship between corruption and economic growth. Mauro (1995) has analysed a data set drawn from Business International (BI) of subjective indices of corruption, the amount of red tape, the efficiency of the judicial system and various categories of political stability for a cross section of countries. He found that corruption lowers private investment, thereby reducing economic growth even in those countries where bureaucratic regulations are very cumbersome. This result fits into the mainstream view of corruption and economic growth: corruption may have a negative effect on economic growth. Mo (2001) also introduces a new perspective on the role of corruption in

[4]The research can be found in the website:
http://theory.people.com.cn/GB/82288/112848/112851/18017456.html

economic growth and provides quantitative estimates of the impact of corruption on the growth and importance of the transmission channels. He found that corruption affects economic growth mostly (53%) through political instability; it also reduces the level of human capital and the share of private investment.

However, there are a few authors who suggest that corruption may raise economic growth, like Leff (1964) and Huntington (1968). In a recent paper, Huang (2016) collected data from thirteen Asia-Pacific countries over the 1997-2013 period and found that there is a significant positive causality running from corruption to economic growth in South Korea, an opposite significant positive causality in China, and no significant causality in other countries. He suggested that the "grease the wheels" hypothesis, suggesting that corruption helps the economy to run smoothly, seems to work in South Korea, and that most anti-corruption campaigns in Asia-Pacific countries do not improve their economic development.

A related literature analyses the determinants of corruption. Rijckeghem and Weder (1997) found that low wages may cause corruption. They developed two efficiency wage models and found that civil service wages are an important determinant of corruption in both a fair wage model and shirking model, while empirical evidence shows a negative relationship between corruption and wages across developing countries. Fan et al. (2009) argues that the more complex the structures of the government is, the more dangerous is the uncoordinated rent-seeking. Treisman (2000) finds five arguments that may reduce corruption: Protestant traditions; a more developed economy and higher quality government; a history of British rule; unitary government; a long period of exposure to democracy and openness to trade. Goel and Nelson (2010) analyse a wide set of historical, geographical and government determinants of corruption and find that both the size and scope of government matter and that historical inertia induces corruption to persist, while geographic

factors can mitigate corruption. Paldam (2002) finds that the economic transition from poor to rich strongly decreases corruption, while high inflation increases corruption. Zhan (2017) uses a sub-national approach from China to find that resource dependence increases the propensity for corruption by state employees. Zhu and Wu (2014) find that mining, real estate and agriculture are the three most corrupt sectors in China. Following these literature, I include foreign direct investment (FDI) per capita across every province over 1998-2015, denoting foreign capital stock and province-level data of the number of civil servants over 1998-2015, denoting structure of government in my empirical model. I also add two dummy variables: 1) former dominated area of western powers at the end of the Qing dynasty; 2) coastal areas denoting historical and geographical factors respectively. I also use provincial GDP per capita as a control variable to eliminate economic development differences among different provinces.

Other than these observable variables, the so-called "cultural dross" is also an important variable influencing corruption, although it is unobserved and difficult to be quantified, so I can only explain its effect intuitively. China has a history of thousands of years and it has developed a huge cultural inertia. Chinese culture is influenced deeply by Confucianism. Some parts of Chinese culture advocate that power is everything and one should gain maximum benefit via any possible means. Although businessmen have been rich since ancient times, their social status is the lowest. There are plenty of examples of businessmen being killed for offending the government in the history of China, such as the famous Ming dynasty businessman Shen Wansan and the Qing dynasty "red top official merchant" Hu Xueyan. The former was sentenced to death because his property was coveted by the emperor; the latter died in poverty for political reasons. Even in modern society, some government officials still frame businessmen in order to possess their property or oppress them. This is an important reason why Chinese businessmen, either ancient or modern,

are more willing to bribe government officials and Chinese people are more accustomed to bribe-giving and bribe-taking. They want not only interest, but also shelter. This kind of "cultural dross" has become deeply ingrained within Chinese citizens' minds over thousands of year. It will take generations of education to remove it. It is very difficult to quantify this kind of variable, so in this chapter we do not discuss it.

To understand what might affect corruption will help the government to suit the remedy to the case and decrease corruption. This chapter will proceed as follows: section 2.1 describes the data I use; section 2.2 describes the model I adopt and my expectations; section 2.3 statistically tests the effects of the mentioned arguments on corruption, discusses the findings and provides plausible explanations; section 2.4 concludes.

2.1 Data

2.1.1 Measurement of Corruption

China provides an ideal case to explore the role of state-owned enterprises (SOEs) on corruption because of its outstanding economic achievement and notoriously corrupt government. In spite of the underlying political stories behind the scenes, like undermining political opponents and witch hunting, dozens of high ranking officials including military officers have been arrested for corruption since the anti-corruption campaign led by Xi Jinping. I start this section by providing a legal definition (the 1997 version) of corruption in the context of China. In China, corruption by state employees is called zhi wu fan zui and the law states that corruption consists of embezzlement (tan wu), bribery (hui lu), misappropriation (nuo yong gong kuan), collective embezzlement (ji ti si fen), holding huge property with unidentified sources (ju'e cai chan lai yuan bu ming), abuse of authority (lan yong zhi quan), dereliction of duty (wan hu zhi shou) and fraud (xun si wu bi). According

to the Procuratorial Yearbook of China, embezzlement and bribery are by far the largest two categories since 1998.

There are different measurements of corruption. Li (2016) provides three types of measurement: perception-based measures, demand-side measures and supply-side measures. I use the data of numbers of annul prosecuted corruption cases. This is a demand-side measure focusing on an objective indicator. The Procuratorial Yearbook of China published by the Supreme People's Procuratorate records the number of annul registered cases of corruption committed by public officials in the procurator's office in each province. I collect the number of cases from 1998 to 2016, since the Criminal Law changed the definition of corruption in 1997 as the dependent variable. The advantage of this dataset is that it is objective and unbiased compared to perception-based measures which are more subjective and easily influenced by the press and other individuals' opinions. My dependent variable *Corr*, denoting corruption, is the number of corruption cases per million people.

2.1.2 State-owned Enterprises (SOE)

Figures 2.1 and 2.2 illustrate the the contribution of state-owned firms to employment. Note that some provinces are empty due to data being unavailable. We can clearly see that since the year of the return of Hong Kong (1997), the employment of state-owned enterprises keep decreasing in every province in mainland China. This trend reflects the development of the Chinese economy, insofar as the public economy used to contribute most to employment in China, but private firms now consist of most employment.

The public-owned economy is a crucial and fundamental part of the Chinese economy, since the Constitution of the People's Republic of China states the dominant role of the public-owned economy. The direct reflection of the public-owned economy is state-owned enterprise. According to the China Statistical Yearbook, in 2011, the share of state-owned

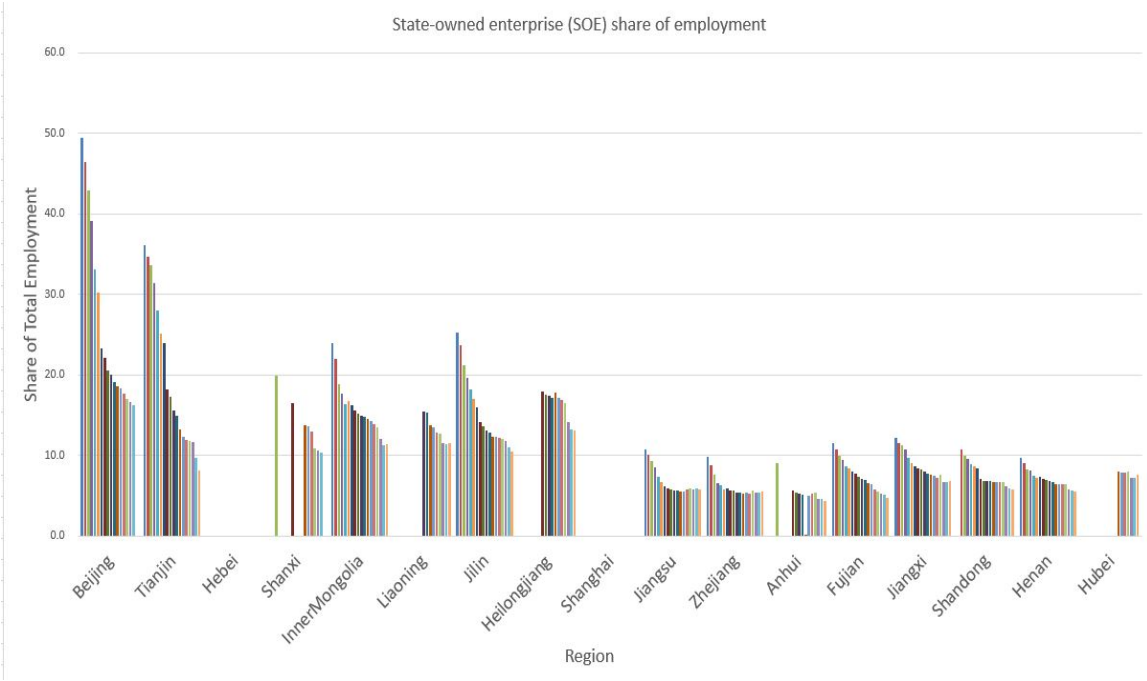

Figure 2.1: State-owned enterprises' share of employment part 1

and state-holding enterprises in gross industrial output was 26.2%, which is a decrease compared to 68.8% in 1998. The employment share of state-owned and state-holding enterprises also dropped from 60.5% in 1998 to 19.8% in 2011. The World Bank and State Department of China forecast that this trend is going to continue and the share of state-owned and state-holding enterprises in gross industrial output will fall to approximately 10% by 2030. However, Xi Jingping has stated that China should develop more state-owned enterprise. Under his administration, the profits of state-owned enterprises have grown fast. A financial report has stated that in 2014, the profit of the four biggest state-owned banks was above 30 billion USD in average and the average profit of the 12 largest state-owned enterprises was more than 10 billion USD. In 2017, the profit of 98 state-owned enterprises gained more than 1.4 trillion RMB, increased 15.2% on a year-on-year basis according to the State-owned Assets Supervision and Administration Commission (SASAC). This is a

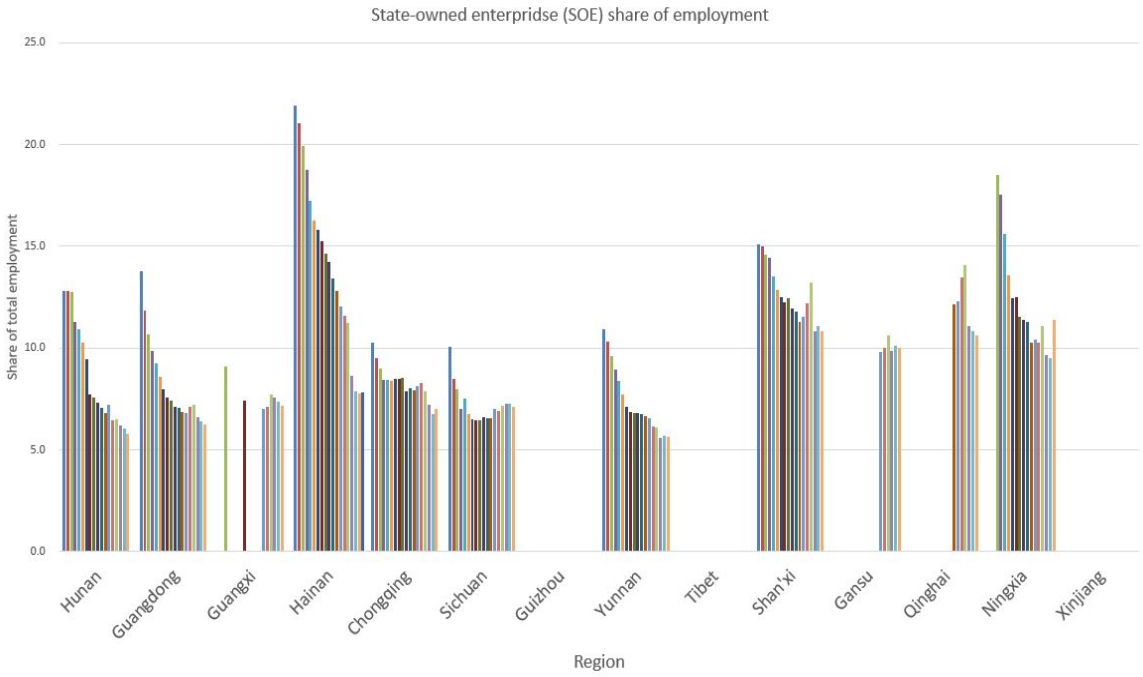

Figure 2.2: State-owned enterprises' share of employment part 2

remarkable achievement in the relatively depressed economy of China.

The aim of state-owned enterprise is to distribute more fairly and benefit all the citizens of China. However, state-owned enterprise is always associated with a rigid system, low efficiency and corruption. Public opinion tends to blame state-owned enterprise for intensifying corruption. I choose the employment share of state-owned enterprises as an indicator of the prominence of state-owned enterprise in each province from 1998-2016 to explore its effect on corruption.

2.1.3 Further Controls

Direct Investment (FDI)

Since Deng XIaoping's reforming and opening market policy, China has introduced billions of foreign direct investment to develop the economy. Figures 2.3 and 2.4 show the

annual net amount of FDI from 1998 to 2015 in different areas of mainland China. We can clearly see that the east coastal area (Jiangsu, Guangdong, Shanghai .etc) receives most foreign capital due to geographical and political factors. However, in recent years, the growth of FDI slows due to political and economic reasons. Foreign investment not only brings capital, but also advanced management and progressive thought. Foreign investment contributes a lot to the economic growth of China, including employment and tax. A recent report points out that the contribution of foreign companies accounts for approximately 16%-34% of GDP and 11%-29% of employment based on data from 1995 to 2013. These two numbers are 33% and 27% respectively in 2013 alone.

Foreign investment and foreign companies should have helped to decrease corruption and make the government more transparent. I choose sub-nation-level data of FDI per capita over the period 1998 through to 2015 as an independent variable in the model.

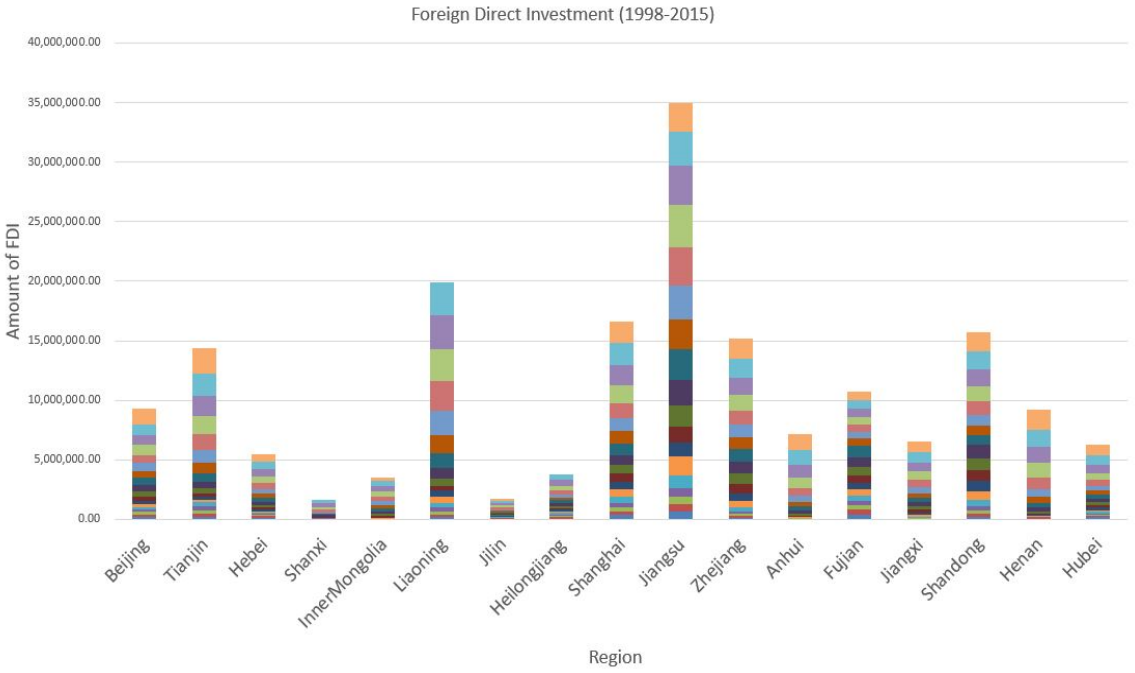

Figure 2.3: Sub-national foreign direct investment part 1

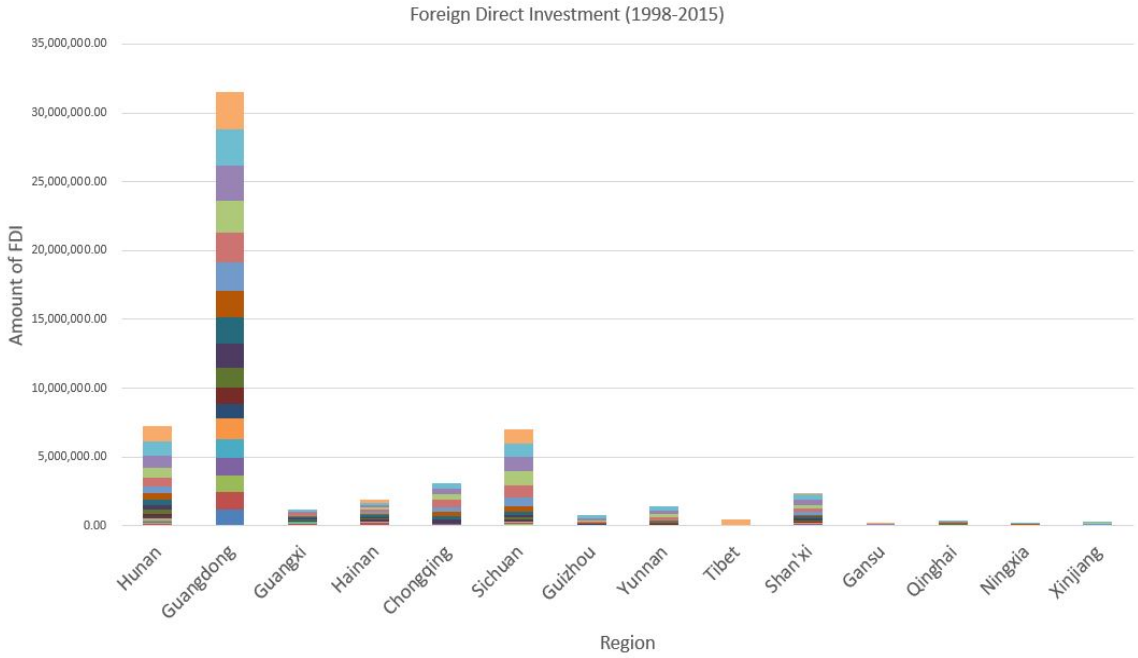

Figure 2.4: Sub-national foreign direct investment part 2

Government Structure

Government plays an important role in modern society, especially for China's "big government, small society" model. Figures 2.5 and 2.6 show the numbers of provincial-level local government employees from 1998 to 2015. We can see all provinces' government employees growing quickly in these 18 years, with certain provinces nearly doubling their employees in local government. Chinese government operates under one-party rule, and therefore lacks competition and supervision. The government is notorious for non-transparency, low efficiency and complexity. To manage such a big population, the government needs to recruit as many civil servants as it can. According to the Ministry of Human Resource and Social Security, the government had 7.16 million civil servants in 2015. The number is not that big compared to the population. However, civil servants are not the only people who need financial-support from government. It is estimated that approximately 70 million people are financially supported within the population. This is a huge burden for government finance. Downsizing has always been a goal for the government although the effect is not significant. According to a recent report, the number of citizens applying for civil servant examination has increased by 377 times in the last 24 years.

The complexity of the government structure and red tape may increase corruption within the government. I choose the number of local government employees from 1998 to 2015 as an explanatory variable in the model.

Historical and Geographic factors

History has a big influence on modern society, especially for China, which has thousands of years of history. Goel and Nelson (2010) argue that the history of a country helps to shape the culture that influences acts of corruption. For example, bribery may be socially accepted in one country while condemned by people in another country due to historical

precedents.

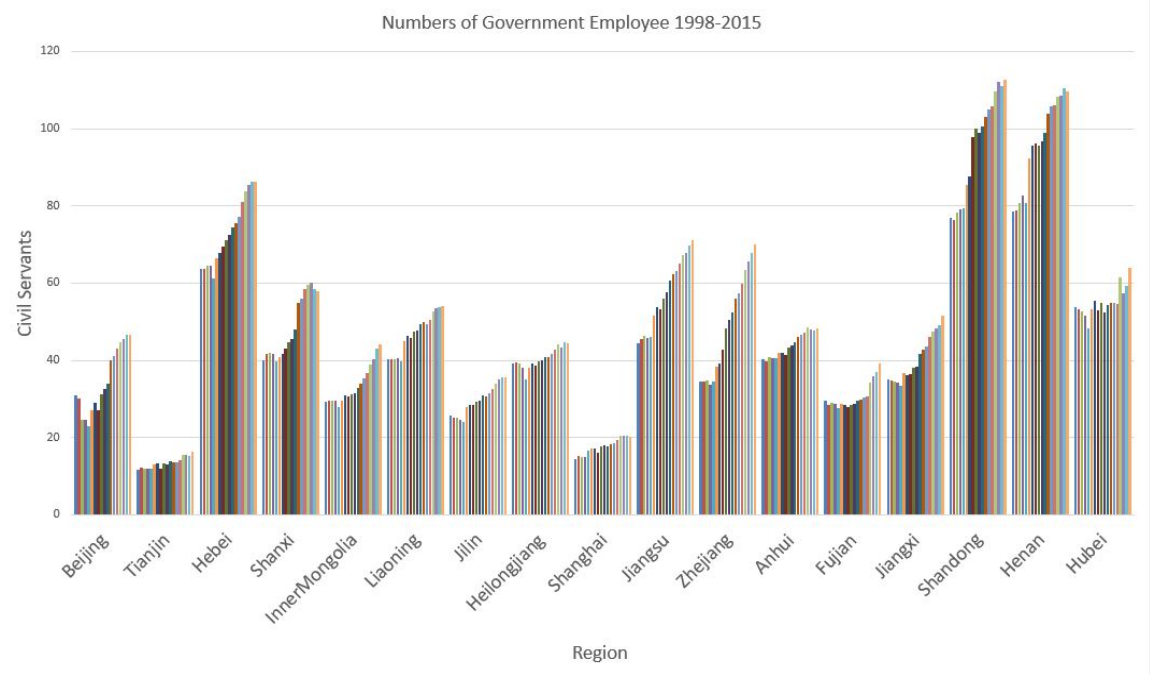

Figure 2.5: Numbers of local government employee part 1

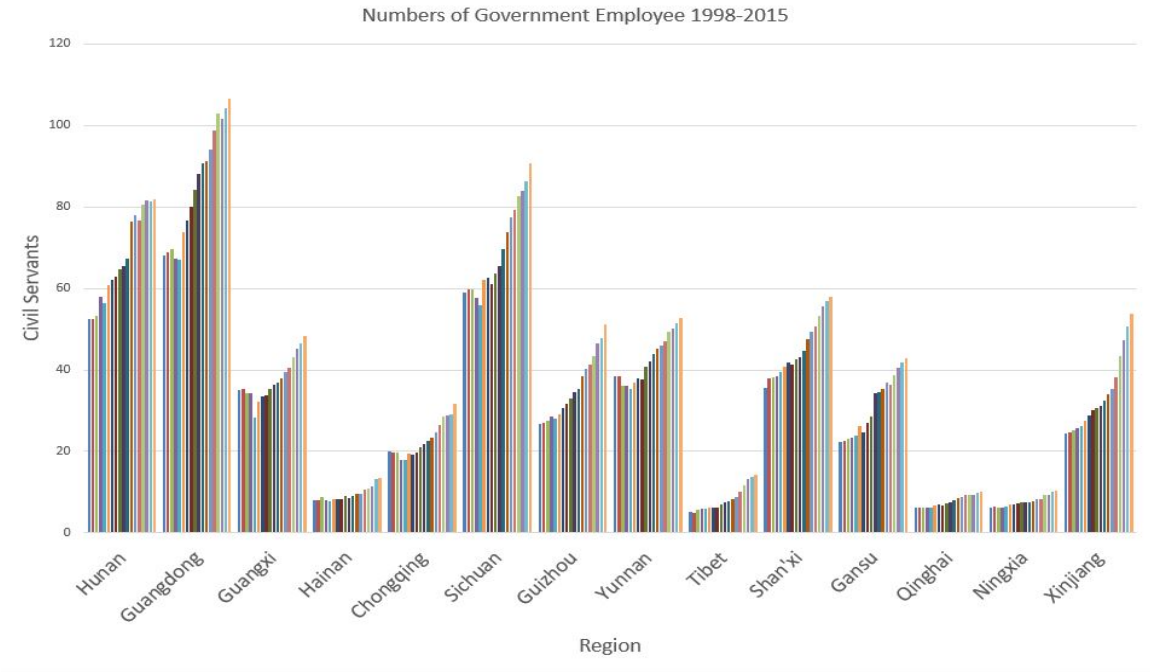

Figure 2.6: Numbers of local government employee part 2

This may explain why corruption is so widespread in Asia-Pacific countries. Treisman (2000) finds that "countries with a history of British rule were robustly rated less corrupt". China has never truly been a colony of western powers. However, at the end of the Qing dynasty, different parts of China were dominated by different countries, such as Germany in Shandong province and Japan in Fujian province. I add a dummy variable in the dataset describing whether the province was once dominated by western countries. Note that I multiply the dummy variable with the time variable, i.e. year, in order not to drop them in the fixed effect regression since dummies variables are time-invariant.

For the historical dummy, there were 5 western powers claiming dominant of areas at the end of the Qing dynasty. dG denotes Germany's dominated area which is Shandong province; dJ denotes Japan's dominated area which is Fujian; dF denotes France's dominated areas which are Yunnan, Guangdong, Guangxi and Hainan; dR denotes Russia's dominated areas which are Heilongjiang, Jilin, Liaoning, InnerMongolia and Xinjiang; dB denotes Britain's dominated area which is Yangtze river basin. Shanghai is a special case since many western powers set up International Settlement in the city and this lasted until the Japanese invaded during World War II.

Geography is also an important factor affecting corruption. Goel and Nelson (2010) point out that larger countries are more likely to engage in corrupt activities due to geographically dispersed locations and "prisoner's dilemma" type of situation. China is a big country with a long coastline, there are 9 coastal provinces (Liaoning, Hebei, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, Guangxi and Hainan) and 2 coastal direct-controlled municipalities (Tianjin and Shanghai). Coastal provinces are usually more developed and urbanized than in-land provinces because of the advantage of geography and preferential policy. dC denotes coastal areas.

All variables are shown in the descriptive table below.

Table 2.1: Descriptive Table

Variable	Obs	Mean	Std. Dev.	Min	Max
Corr	206	36.6165	11.97165	15	89
SOE	206	9.447772	3.978359	0.114155	21.93144
FDI	206	174.6252	211.6646	2.12	1366.13
GovStr	206	50.95243	27.933	7.1	112.8
IniGDP_Pop	206	649.0152	615.915	0	2067.87
GDP	206	37.73895	21.64256	4.652	107.96
Germany_Year	206	97.58738	433.0908	0	2015
Japan_Year	206	58.57767	339.0227	0	2015
France_Year	206	321.8981	738.8263	0	2015
Russia_Year	206	292.7961	710.9159	0	2015
Britain_Year	206	604.9612	924.2104	0	2015
Coast_Year	206	761.0728	977.3314	0	2015
FP_Year	206	1375.82	936.4144	0	2015

2.2 Empirical Model

The econometric model I use is represented as follows:

$$Corruption_{it} = \beta_0 + \beta_1 SOE_{it} + \beta_2 X_{it} + \gamma_i + \epsilon_{it}$$

$$i = 1, 2, 3, ..., 31; t = 1998, 1999, 2000, ..., 2016$$

In determining the causes of corruption in Mainland China, the dependent variable *corruption*, denoting the level of corruption, is the number of cases prosecuted for corruption per million people. Independent variables include the presence of state-owned enterprises (SOE) which is measured by state-owned enterprises' contribution to the share of total employment; X is a vector of controls including the foreign direct investment (FDI), which is measured by the amount of foreign direct investment per capita; the government structure ($GovStr$), which is measured by the number of local government employees; (GDP) which is measured by local GDP per capita and two dummy variables which indicate historical factors (whether a former foreign power dominated area) and geographic factors (whether a coastal area) respectively. The database I set up is panel. γ_i denotes province fixed ef-

fects and ϵ_{it} denotes the error term, subscript i denotes provinces in Mainland China and t denotes the time period from 1998 to 2016.

I expect variable SOE to have a positive effect on corruption, which is consistent with general public opinion. Citizens tend to blame state-owned enterprise for low efficiency, corrupt, rigidity and nepotism. I think there are several reasons why state-owned enterprise has a tight relationship with corruption in public opinion. Firstly, state-owned enterprises are mostly a monopoly. The government forbids private investment and foreign investment entering certain fields, such as the power sector, petroleum industry, banking system and telecom industry. There are many famous monopoly SOEs like PetroChina, Sinopec and ICBC (Industrial and Commercial Bank of China). These companies' monopoly is due to policy instead of market. Administrative monopoly breeds corruption. SOEs could rig government tender and have unfair competition advantage over private companies. Monopoly SOEs increase cost and hurt the whole industry. The second consideration is SOEs' lack of regulation. All state-owned enterprises belong to State-owned Assets Supervision and Administration Commission (SASAC) nominally. However, many powerful families of high-ranked officials have huge influence on SOEs, such as a former member of the standing committee, Zhou Yongkang, who used to dominate the petroleum industry. With Zhou Yongkang's downfall, dozens of CEOs and senior executives in petroleum industry were arrested for corruption. There is no third party supervising SOEs, so real profit and money transfer are usually a black-box operation. Thirdly, SOEs are notorious for nepotism. CEOs of state-owned enterprises tend to fill key positions with their relatives or cronies and recruitment of SOEs tends to hire current employees' offspring, particularly within the power sector. Nepotism hurts fair competition and results in over-staffing which makes SOEs rigid and lowers efficiency. Finally, state-owned enterprises have administrative establishment, some being equal to department level and some to ministry level. These Chinese character-

istics cause CEOs of state-owned enterprises to be more likely to connect with government officials through benefit transferring.

I also expect complexity of government structure to contribute to more corruption. Goel and Nelson (2010) argue that bigger government has greater bureaucracy and red tape and is more likely to engage in corrupt activities. Fan et al. (2009) finds those countries with a larger number of government or administrative employees and a larger civil service to reported more frequent bribery. this is quite easy to understand. With a larger number of government employees, the structure must be more complex than before, therefore it is more difficult to regulate the whole government. The complex structure of the government may result in internal friction and mutual excuse-making. For example, when an accident happens, different departments are more like to blame each other instead of taking responsibility. Another disadvantage is that citizens need to spare more time to process government related stuff. People in China are always complaining that it is difficult to process government related stuffs, such as tax paying and application for government statement. Citizens need to endure government employees' arrogance and red tape to get things done. Lack of regulation is the first reason why bigger governments are more likely to engage in corrupt activities. Chinese government, either central government or local government, is one-party rule. The Discipline Inspection Commission (DIC) is responsible for regulation. Xi Jingping's ally Wang Qishan was the former secretary of the Central Discipline Inspection Commission. The DIC contributes a great deal to fighting corruption. However, without an independent third party, the DIC is often used as a tool to undermine political opponents and political "witch hunt". Nepotism is also an important reason for corruption in bigger government. Members of the standing committee are the most powerful group of people in China. They have a complicated interpersonal relationship. Heads of local government are usually tightly connected with members of the standing committee. In exchange for their

loyalty, members of the standing committee often turn a blind eye to their bribe-taking activities or even shelter them when there is an investigation against said officials. Many corruption cases end up with nothing because of high-ranked officials interfering. This is an aeipathy for Chinese government. Other reasons, such as financial burden or invisible benefit of civil servants, also contribute to intensifying corruption. For example, government employees used to need not to pay for their pension while enjoying a larger pension than other citizens after retirement. This policy was abolished a few years ago and the government immediately raised employees' pay checks.

Foreign direct investment (FDI) would decline corruption in the general opinion of the Chinese people. Greater prosperity lowers corruption by making people, including both citizens and civil servants, relatively rich, therefore government employees' eagerness to take bribes is reduced. FDI increases local employment and incomes and brings not alone advanced management but also a democratic ethos. Democracy is an effective way to fight corruption and although the government's system is far from democracy, it would be influenced by democratic sentiments to some extent. The government also needs to reform to reduce corruption in order to appeal to foreign investors. Based on these reasons, I expect variable FDI to have a negative effect on corruption.

Geographic factors also play a role in influencing corruption. According to a report on provincial government, the east coastal area occupied 57.8% of total GDP in 2015. People in coastal areas are relatively wealthier than in-land people. The east coast area is also more urbanized than in-land areas which leads to better education and access to public services. Wealth and education both lead to coastal area residents having more civic consciousness and less tolerance of government misconduct. Therefore, local governments in coastal areas are forced to behave and listen more to citizens. They also act less boldly regarding civil issues than their in-land counterparts. I anticipate that geographic factors would result

in less corruption.

Historical factors have always played an important role in modern China, since the country has thousands of years of history. I choose former western power rule as the dummy variable. I expect former rule of a western power would to reduce corruption since these states had better legal systems and more advanced government structures than the Qing government at that time, which would have an impact on local culture and change it to some extent. Taking Hong Kong as an example, it is considered the least corrupt city in the People's Republic of China. Hong Kong had a history of more than 100 years of British rule until 1997. British legal culture and democracy have influenced Hong Kong deeply, which makes the city one of the least corrupt areas in the world. Shanghai is another good example, with former rule by different western powers simultaneously. It has now become one of the most advanced cities in China and is believed to be one of the least corrupt cities.

2.3 Empirical Results

Table 2.2 shows the result of ordinary least squares (OLS) fixed effect regression and table 2.3 shows the result of the same regression without province fixed effect as a check on robustness. We can clearly see that without province fixed effect, the standard error of dummy variables in table 2.3 is much larger than that in table 2.2 which means the data is more spread out from the mean value without province fixed effect. Therefore, the data of dummy variables performs better with province fixed effect.

In the first column of table 2.2, I only include variable SOE and GDP in my model, we can see the coefficient of SOE is negative. In the second column, I add variable FDI in the regression and the coefficient of SOE is negative as well. In the third column, I add variable $GovStr$ in the regression, the coefficient of SOE is still negative. However, in the fourth and fifth column, I add historical and geographic dummies in the regression, the co-

efficient of SOE is positive, which is inconsistent with the results of the first three columns regarding the coefficient of SOE. The inconsistency of the results may potentially be due to the endogeneity of SOE. Many factors may cause endogeneity, such as omitted variable bias, measurement error in independent variables and simultaneous causality. In our case, reverse causality may be an issue. However, reverse causality occurs when the causality runs in both direction which means dependent variable ($Corr$) affects independent variable (SOE) and vice versa. For instance, more corrupt officials and bureaucrats may push the agenda, which requires establishment of more state-owned enterprise locally, in order to embezzle for personal gain. Therefore, regions featuring more corruption may progressively grow a larger public sector as public employment is used as a reward in patron-client relationships. When there is reverse causality, the independent variable is correlated with the error term and OLS estimation picks up both forwards and backwards effect which results in bias and inconsistent coefficients. To address the problem of endogeneity, we use two-stage least squares (2SLS) regression.

First we need to find a valid instrumental variable which is uncorrelated with the error term and be relevant for the enodogenous variable. In our case, a suitable instrument candidate for state-owned enterprises is a variable that is correlated with state-owned enterprises but does not directly affect corruption. Relying on Chinese recent history, I identified a suitable instrument. The People's Republic of China (PRC) was founded in 1949. As a communist country, it was deeply influenced by the Union of Soviet Socialist Republics (USSR). The government tried to set up a series of state-owned enterprises to achieve public ownership of production materials. When choosing the location for these state-owned enterprises, the government's mainly consideration is to boost local economy through the set-up of state-owned enterprises since the Chinese Communist Party (CCP) was founded to help the poor and eliminate the inequality. Therefore, the government transfers capital

and human resources from relatively more advanced provinces to relatively depressed areas to set up state-owned enterprises to foster local development. GDP is the best indicator reflecting local economy thus I collect data of sub-national GDP of 5 years in total from 1950 to 1954, which is correlate with the initial set-up of state-owned enterprises. To capture the dynamic of today's change, I combine it with the local population figures from 1998 to 2016. The variable $IniGDP\_Pop$ in table 2.1 denotes the instrument variable I choose.

Now we run the two-stage least squares (2SLS) regression. Tables 2.4 and 2.5 show the results of first and second stage of two-stage least squares (2SLS) regression. Note that in column 6 I merge the five historical dummies into one dummy variable FP_Year trying to improve the efficiency of the estimation by reducing the number of variables although. In table 2.4 ,we can see that the correlation between independent variable SOE and instrumental variable $IniGDP\_Pop$ is negative in all 6 columns. In table 2.5, we see the coefficient of SOE in all 5 columns is positive and consistent. Although only coefficients in the first three columns are statistical significance casting some doubts on the results, overall the results in Table 2.5 suggest that state-owned enterprises have a positive effect on corruption. Taking column 6 as an example, a standard deviation increase in SOE increases corruption by 250%.

As for other controls, in column 6, a standard deviation increase in FDI decreases corruption by 1.86% which is consistent with previous expectation; a standard deviation increase in $GovStr$ increases corruption by 8.12% which is also consistent with previous expectation. However, geographic dummy $Coast\_Yeat$ increase the level of corruption in both column 5 and column 6 which is contrary to the previous expectation. This is because the Chinese government is a centralized system hence local government has less autonomy in terms of law and executive. The central government is relatively corrupt which also influences local government whether in-land or coastal. The merged historical dummy

Table 2.2: OLS Regression

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SOE	SOE	SOE	SOE	SOE	SOE
SOE	-0.393	-0.754**	-0.768*	0.137	0.183	-1.211***
	(0.368)	(0.379)	(0.401)	(0.459)	(0.450)	(0.429)
FDI		-0.0331***	-0.0329***	-0.0282***	-0.0228***	-0.0314***
		(0.00767)	(0.00792)	(0.00778)	(0.00783)	(0.00809)
GovStr			0.0194	0.121	0.0951	0.0619
			(0.168)	(0.155)	(0.151)	(0.165)
Germany_Year				-1.094*	-0.349	
				(0.592)	(0.633)	
Japan_Year				-0.402	0.363	
				(0.777)	(0.804)	
France_Year				0.403	1.162***	
				(0.323)	(0.410)	
Russia_Year				2.603***	2.414***	
				(0.444)	(0.439)	
Britain_Year				-0.575**	-0.481*	
				(0.263)	(0.260)	
Coast_Year					-0.999***	-1.052***
					(0.342)	(0.285)
FP_Year						0.229
						(0.267)
GDP	0.137***	0.255***	0.247***	0.233***	0.290***	0.282***
	(0.0393)	(0.0466)	(0.0805)	(0.0865)	(0.0868)	(0.0854)
Constant	35.34***	39.90***	39.30***	-388.1	6.547	526.1
	(4.552)	(4.701)	(7.027)	(332.7)	(352.5)	(355.7)
Observations	206	206	206	206	206	206
R-squared	0.130	0.216	0.216	0.421	0.449	0.2747

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2.3: OLS Regression without Province Fixed Effect

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SOE	SOE	SOE	SOE	SOE	SOE
SOE	0.679***	0.730***	0.491**	-0.126***	-1.268***	0.419*
	(0.203)	(0.201)	(0.230)	(0.251)	(0.252)	(0.237)
FDI		-0.0214***	-0.0248***	-0.0240***	-0.0263***	-0.0200***
		(0.00562)	(0.00579)	(0.00455)	(0.00538)	(0.00641)
GovStr			-0.0717***	-0.155***	-0.156***	-0.0675*
			(0.0341)	(0.0312)	(0.0313)	(0.0343)
Germany				-4.164	-5.778	
				(3.308)	(3.873)	
Japan				-8.393***	-9.932**	
				(4.101)	(4.529)	
France				-10.32***	-11.58***	
				(1.961)	(2.511)	
Russia				16.28***	16.07***	
				(2.068)	(2.085)	
Britain				-11.72***	-12.18***	
				(1.864)	(1.953)	
Coast					1.676	-3.821*
					(2.086)	(2.087)
FP						0.224
						(1.943)
GDP	0.0225	0.175***	0.209***	0.174***	0.175***	0.205***
	(0.0372)	(0.0547)	(0.0567)	(0.0451)	(0.0451)	(0.0565)
Constant	29.65***	26.87***	32.06***	57.30***	57.65***	33.13***
	(2.496)	(2.560)	(3.541)	(4.004)	(4.032)	(4.056)
Observations	206	206	206	206	206	206
R-squared	0.052	0.111	0.131	0.486	0.488	0.147

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2.4: First Stage Results

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	SOE	SOE	SOE	SOE	SOE	SOE
IniGDP_Pop	-0.00438***	-0.00446***	-0.00319***	-0.00157	-0.00344***	-0.00188*
	(0.000478)	(0.000478)	(0.00102)	(0.000972)	(0.00112)	(0.00111)
FDI		0.00970***	0.00805***	0.00747***	0.00435*	0.00487*
		(0.00246)	(0.00273)	(0.00239)	(0.00254)	(0.00280)
GovStr			-0.0344	-0.0686***	-0.0325	-0.0602***
			(0.0245)	(0.0217)	(0.0241)	(0.0253)
Germany_Year				0.000109	-0.000800	
				(0.000728)	(0.000770)	
Japan_Year				-0.00384***	-0.00508***	
				(0.000605)	(0.000707)	
France_Year				-0.00200***	-0.00287***	
				(0.000380)	(0.000459)	
Russia_Year				0.000559	0.000550	
				(0.000394)	(0.000389)	
Britain_Year				-0.00285***	-0.00299***	
				(0.000333)	(0.000331)	
Coast_Year					0.00149***	0.000283
					(0.000455)	(0.000388)
FP_Year						-0.00190***
						(0.000322)
GDP	-0.0251*	-0.0819***	-0.0677***	-0.0726***	-0.0780***	-0.0545**
	(0.0136)	(0.0204)	(0.0227)	(0.0199)	(0.0197)	(0.0219)
Constant	14.35***	14.78***	15.41***	18.66***	18.14***	18.21***
	(0.548)	(0.553)	(0.709)	(0.749)	(0.756)	(0.837)
Observations	381	381	381	381	381	381
R-squared	0.187	0.225	0.229	0.443	0.459	0.298

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 2.5: Second Stage Results

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Corr	Corr	Corr	Corr	Corr	
SOE	1.566***	1.593***	4.446**	3.490	3.666	2.507
	(0.427)	(0.411)	(2.247)	(5.131)	(3.714)	(4.407)
FDI		-0.0242***		-0.0190**	-0.0191*	-0.0186**
		(0.00592)		(0.00920)	(0.0105)	(0.00804)
GovStr			0.239	0.173	0.185	0.0812
			(0.166)	(0.356)	(0.260)	(0.316)
Germany_Year				0.000811	-0.000875	
				(0.00302)	(0.00356)	
Japan_Year				0.0105	0.0109	
				(0.0161)	(0.0124)	
France_Year				-0.00101	-0.000941	
				(0.00472)	(0.00416)	
Russia_Year				0.00170	0.00144	
				(0.00710)	(0.00520)	
Britain_Year				0.00364	0.00397	
				(0.0103)	(0.00767)	
Coast_Year					0.000115	0.00133
					(0.0182)	(0.0170)
FP_Year						0.00183
						(0.0378)
GDP	0.0203	0.190***	-0.0270	0.106	0.103	0.164
	(0.0385)	(0.0570)	(0.0656)	(0.104)	(0.0929)	(0.110)
Constant	21.40***	18.60***	-16.11	-8.743	-11.16	4.347
	(4.322)	(4.308)	(28.25)	(71.36)	(51.87)	(60.79)
Observations	206	206	206	206	206	206
R-squared		0.030				

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

FP_Year has a positive effect on corruption while different foreign power has mixed effect on corruption in the first 5 columns. This is because the duration of western powers rule is different. For example, Britain ruled Hong Kong for more than 100 years while Germany ruled Shandong province only till World War I. Some influence may last, some may vanish relatively quickly.

2.4 Conclusion

This chapter studies the impact of state-owned enterprises on the level of corruption in mainland China. My analysis shows that state-owned enterprises would increase the level of corruption due to bribery, nepotism and other reasons. This is consistent with the public opinion that state-owned enterprises are deeply corrupt and have negative impact on the society.

To enrich these arguments, I include in my model a set of controls suggested in the reviewed literature and find some results in line with the general findings. In particular, I find foreign capital stock (denoted by foreign direct investment) would decrease corruption, while the complex structure of government (denoted by numbers of local government employee) would increase corruption. I also add two dummy variables denoting historical and geographic factors. I find that location in coastal areas would also increase corruption. I use the former rule of Western powers at the end of the Qing dynasty as a historical factor and find that it has a mixed effect on corruption.

Due to endogeneity, I find an instrumental variable for state-owned enterprises and run the two-stage least squares (2SLS) regression. Although my 2SLS results suggest that state-owned enterprise increases local corruption, the lack of robustness and the nature of data used to measure corruption warns against easy generalizations. More analysis and better data are needed to credibly establish a causal relationship between state-owned enterprises

and corruption.

Conclusion

In the first chapter, we study the distribution of wealth using a representative consumer model with endogenous labour supply. We also adopt two heterogeneities: tastes and initial wealth. We find that in regard to the cross section of labour supply, there is no dynamic. We also find that how the wealthy and the poor tend to change their condition in the cross section of consumption and wealth during different business cycles. In the last part of the first chapter, we apply the representative consumer theory to the Ramsey growth model to derive distribution predictions.

In the second chapter, we mainly focus on the impact of state-owned enterprise on the level of corruption. We also include several controls suggested by the literature under review. We find that state-owned enterprises do increase the level of corruption, which is consistent with general opinion. We also find that openness to trade reduces corruption and the complex of the structure of government increases corruption. As for the coastal geography dummy, it surprisingly increases corruption. Historical dummies have a mixed effect on corruption.

I hope my findings will help policy makers to reduce income inequality and better fight corruption in government.

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