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Size, Determinants, and Consequences of Corruption in China's Provinces: The MIMIC Approach

Abstract

This paper uses a multiple indicators and multiple causes (MIMIC) model and estimates the extent of corruption in 30 Chinese provinces from 1995 to 2015. Treating corruption as an unobserved latent variable, the MIMIC results show that both government size and public investment have significant positive effects on corruption, while fiscal decentralization, citizen education level, average public sector wages, intensity of law enforcement, media supervision, political control and FDI all have significant negative effects on corruption. Among them, education level, size of public investment, intensity of law enforcement and political control are the most important determinants of China's corruption. Additionally, we find that corruption decreases GDP and residents' income significantly. In the 30 provinces the corruption index shows a negative trend from 1995 to 2015. Comparing the extent of corruption in the eastern, central and western provinces, we also find that the more developed the region, the lower the extent of corruption.

JEL-Codes: D720, D730, H110, H770, K420.

Keywords: corruption index, determinants and consequences, MIMIC model, China's provinces.

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1. Introduction

Corruption is a critical problem all over the world. According to the corruption perceptions index 2017, most developing countries and transitional countries were suffering from serious corruption, and among them, Sub-Saharan Africa, Eastern Europe and Central Asia were the most corrupt regions, with an average score of 34 in an assessment of incorruptibility with total score of 100.[1] Although hypotheses around whether corruption promotes ("greases") or delays economic development have been discussed for a long time,[2] it's widely believed that corruption is a major problem for many developing countries, restraining economic growth, increasing income inequality and destabilizing political stability (Ackerman and Palifka, 2016). Aidt (2009) refuted the "grease hypothesis" at both micro and macro level. Through analyzing micro-survey data, he found that enterprises faced more costs in places with higher regulation and corruption. In addition, empirical analysis with macro data also demonstrated that corruption had a significant negative effect on per capita wealth, meaning that it harms sustainable development. Even the most developed country in the world, the US, suffers from corruption. Apergis et al. (2010) found that the Gini coefficient in the US increased by 0.069 when corruption increased by 1%. Moreover, IMF (2016) noted that corruption induced annual global losses of US$2 trillion and caused less economic growth, reduced public revenues and increased poverty.[3] Due to the negative effects and widespread existence of corruption, many countries implemented anti-corruption policies. China, the Philippines and South Korea have all strengthened detection and punishment of corrupt activities in recent years. However, corruption is an ancient issue. It has existed since the birth of public power, and will last as long as government exists.

Accurate measurement of corruption is crucial for corruption prevention and has

[1] The specified data can be seen on the website of Transparency International (TI), and according to the corruption perception index, the lower the score, the higher the corruption. https://www.transparency.org / news/feature/ corruption_perceptions_index_2017.

[2] For example, Huang (2016) checked the correlation between corruption and economic growth in Asia-Pacific countries and found that corruption had a significant positive relationship with economic growth in China and South Korea, however, it seemed that corruption had no significant effect on economic growth in the remaining countries.

[3] Data source: https://www.cnbc.com/2013/10/09/imf-says-start-of-fed-tapering-threatens-23-trillion-bond-losses.html.

become important in corruption research. Tanzi (1998) believed that corruption would likely be eliminated if it could be measured precisely and timely. Andersson and Heywood (2009) pointed out that if a clear cause-and-effect relationship between corruption and other factors could be established, it would be possible to find effective solutions preventing corruption. However, due to the unobservability and complexity of corruption, it's difficult to measure corruption directly in a country or region. Currently, the most popular methods are subjective perception indexes and objective indicator methods. Subjective perception indexes are mainly derived from questionnaire surveys such as the corruption perceptions index (CPI) and Bribe Payers Index (BPI),[4] and the objective indicators are mainly represented by the amount of corruption cases, officials or money involved in corruption. However, neither subjective indexes nor objective indicators reflect the extent of corruption comprehensively and accurately, and many scholars have argued about bias in these indicators.[5] Considering the multiple causes and consequences of corruption, Dreher et al. (2007) conducted pioneering research which constructed a MIMIC model to measure corruption in 100 countries all over the world. As MIMIC models are a reliable method to measure unobservable latent variables, their corruption research attracted much attention and also provides a feasible approach for us to measure corruption in China's provinces.

China faces problems of corruption[6] and its anti-corruption campaign, which began in 2013, has gained worldwide attention. However, there is still no available indicator to accurately measure disaggregated corruption in China's provinces. In this paper, considering corruption as an unobserved latent variable, we build a Multiple Indicators and Multiple Causes Model (MIMIC) through analyzing the determinants and consequences of corruption in China, and for the first time construct a corruption index

[4] CPI and BPI both are published by Transparency international (TI) to measure the extent of corruption in countries all over the world. CPI was first published in 1995 and BPI was first published in 1999.

[5] We will discuss the advantages and disadvantages of these indictors in detail in chapter 2.

[6] In the incorruptibility rankings produced by Transparency International from 1995 to 2017, the average rank of China in the world is around 75; a very low score which demonstrates that there is still much corruption in China.

for China's provinces from 1995 to 2015. We carry out this research for three purposes: first, we hope to provide reliable data for researchers interested in corruption, institution quality and public governance of China's provinces; second, we hope to provide an effective method for policy makers to monitor corruption in different districts and periods; and last, we hope to offer a helpful decision base for anti-corruption through analyzing the determinants and consequences of corruption.

Our paper consists of six parts. In part 2, we explore some theoretical considerations including definition, measurement methods, determinants and consequences of corruption. In part 3, all variables and data, the estimation model and the final regression results are presented. Part 4 constructs a corruption index of China's provinces from 1995 to 2015 based on the MIMIC analysis results, also analyzing distribution and variation of corruption in China. In part 5, we check the robustness of the estimation model and results. Finally, part 6 concludes our main findings on China's corruption and offers some policy recommendations for reducing corruption.

2. What do we know about corruption?

2.1 What is corruption and how can it be measured?

As an ancient and worldwide issue, much effort has been made to define corruption. However, a common definition is still difficult, because differences in culture, legal system, history, traditions and moral values will result in different understandings of corruption. The classical definition is that corruption is an abuse of entrusted power for private gain (Shleifer and Vishny, 1993). Transparency International (TI) divides corruption into three levels: grand corruption, petty corruption and political corruption.[7] However, Huberts (2010) argues that not all acts misusing office to pursue private

[7] Grand corruption consists of acts committed at high levels of government that distort policies or the central functioning of the state, enabling leaders to benefit at the expense of the public good. Petty corruption refers to everyday abuse of entrusted power by low- and mid-level public officials in their interactions with ordinary citizens. Political corruption is a manipulation of policies, institutions and rules of procedure in the allocation of resources and financing by political decision makers, who abuse their position to sustain their power, status and wealth. The detailed classification can be seen on the TI website, https://www.transparency.org/what-is-corruption#define.

profits are corruption, and a precise definition should concentrate on all types of violations. He concludes that corruption includes bribery, favoritism, conflicts of interest, fraud and theft. Considering corruption in China's provinces, we adopt Johnston's (1996) definition that corruption refers to abuse, according to local legal or social standards, of a public role or resource for private benefits, and according to the legal system in China. The main categories of China's public-sector corruption are *Tanwu* (embezzlement), *Shouhui* (bribery), *Duzhi* (malfeasance), *Gongkuanxiaofei* (consuming public funds illegally), *Bumingcaichan* (property with unidentified sources), *Toushuiloushui* (tax evasion), *Shenghuozuofeng* (bigamy and extramarital affairs) and *Yiquanmousi* (other behaviors pursuing private interests with public power).[8]

How can we measure corruption? Existing estimation methods include subjective corruption indexes, objective corruption indicators and the model evaluation approach. The representative corruption indexes include the Corruption Perceptions Index (CPI) and the Bribe Payers Index (BPI) published by Transparency International, and corruption indexes published by Business International and International Country Risk Guide. Subjective corruption indexes, mainly based on questionnaire surveys of perceptions of corruption, have been applied in numerous studies and help in understanding corruption levels in different countries and regions.[9] However, some recent studies have shown that the Corruption Perceptions Index isn't a reliable indicator (Andersson and Heywood, 2009; Olken, 2009). Analyzing 60 countries' data from GCB[10] (Global Corruption Barometer) and CPI (Corruption Perceptions Index), Abramo (2005) found that, compared with perceptions of corruption, the experiences of individuals and families better reflected the actual degree of corruption. Mocan (2008) reported that there was no obvious linear relationship between corruption measured by

[8] Ko and Weng (2012) listed more typologies of China's corruption in their paper.

[9] These subjective perception indexes of corruption were used by Treisman (2000), Fisman and Gatti (2002), Lessmann and Markwardt (2009), Fan, Chen and Treisman (2009), Lalountas, Malonas and Vavouras (2011) and many other related studies.

[10] The GCB index is based on the real experience of corruption among ordinary people, while the CPI is built on perceptions of corruption among business people involved in international business.

micro-survey data and the corruption perception indexes published by TI, BI, and ICRG. Razafindrakoto and Roubaud (2010) found corruption levels perceived by experts irrelevant to true levels of corruption based on household surveys, and that experts' perceptions overestimated corruption levels.

Due to disadvantages in the subjective corruption indexes, many researchers prefer objective corruption indicators for measuring the extent of corruption in countries and districts. These indicators are based on actual statistics, such as corruption cases detected by the law, and funds involved in corruption. Yet, these indicators represent only a very small part of total corruption, since undetected corrupt behaviors will inevitably lead to underestimation of corruption. Many studies on corruption in China's provinces and municipalities use the number of embezzlement, bribery and malfeasance cases or the amount of public goods involved in cases detected to represent the volume of corruption. For instance, researchers including Wu (2008), Wu and Rui (2010), Dong and Torgler (2013) all used the number of detected embezzlement, bribery and malfeasance cases per million public servants to measure the extent of corruption in China's provinces, while researchers like Fu and Rong (2010) used corruption cases per 10,000 public servants to represent the anti-corruption strength of the government. By collecting and analyzing 2803 corruption cases reported in *Procuratorial Daily* from 2000 to 2009, Gong et al. (2012) found that the scale of corruption in China was rising, and corruption behaviors were concentrated in areas such as government procurement and project contracting. In contrast, Ko and Weng (2012) analyzed corruption cases in China in the 2000s, finding that corruption had decreased significantly due to administrative reform. Actual corruption indicators are also used in other countries. Del Monte and Papagni (2001) used the number of corruption cases to measure the extent of corruption in Italy. Mocan (2008) surveyed over 5500 people from 30 countries and used the proportion of respondents asked to pay bribes to receive services from government or public staff to represent corruption. Razafindrakoto and Roubaud (2010) used the amount of money illegally paid to government officials by respondents to

represent corruption in a direct survey of 3500 households in eight sub-Saharan African countries.

Subjective indexes are mainly used in transnational corruption research and objective indicators are mainly used in studies on disaggregated corruption in districts of a country. However, it's clear that both methods have shortcomings. The corruption perception indexes show less correlation with the extent of corruption and can't reflect the actual extent. The objective indicators underestimate the real extent of corruption. Neither of the two measurement methods take the causes and consequences of corruption into account. Hence, an effective and reliable measurement method for corruption is urgently needed. Dreher et al. (2007) adopted a special form of the structural equation model, the multiple indicators multiple causes method (MIMIC), to construct a corruption index from 1976 to 1997 for 106 countries, and found that factors like rule of law, primary school enrolment rates and the extent of democratization have significant negative impacts on corruption and that developed countries have lower levels of corruption than developing countries. Zhang et al. (2009) also constructed a simple Structural Equation Model to explain how social support systems determined corruption and predicted the extent of corruption all over the world. Their research provided a reliable method to measure the extent of corruption in different countries and regions while exploring the determinants and consequences of corruption.

2.2 What Determines Corruption?

Corruption is determined by many factors, including political systems, judicial systems, sociocultural, historical and economic factors (Treisman, 2000; Del Monte and Papagni, 2007; Dong and Torgler, 2013). Many research achievements have been produced in this field. Tanzi (1998) generalized causes of corruption into direct and indirect causes. Direct causes include government regulation and authorization, taxation, public expenditure, government goods and services offered below market price, discretionary power, financing for political parties, etc. Indirect causes include the quality of

bureaucratic institutions, public sector wage levels, punitive mechanisms, institutional controls, regulations, and transparency of laws and procedures. Treisman (2000) considered that corruption was influenced by factors such as religious traditions, colonial inheritance and legal systems, ethnic segregation, raw materials and rents, economic development, federal structures, democracy, trade openness and public servants' wages. Dimant and Tosato (2017) summarized 28 causes and 12 consequences of corruption through analyzing existing literature and conducting a further survey.[11] We present the main causes of corruption summarized from existing research and especially consider causes affecting corruption in different periods in the same country.

2.2.1 Government Size

Government size is regarded as a proxy for government participation in market and social activities as well as an indicator of regulatory intensity. The impact of government size on corruption is controversial. One view is that the expansion of government provides more opportunities for rent-seeking, thus increasing corruption (Alesina and Angeletos, 2005; Rose-Ackerman, 2016). Goel and Nelson (1999) showed that the size of state and local government in the United States had a significant positive impact on corruption. By analyzing data from OECD countries and Latin American countries between 1996 and 2003, Arvate et al. (2010) found that government size was the Granger cause of corruption. The opposite view is that larger governments promote checks and balances in government departments, so government expansion will reduce corruption (Goel and Budak, 2006). Billger and Goel (2009) and Goel and Nelson (2010) demonstrate that there is a negative correlation between government size and corruption. However, cross-country research conducted by Kotera et al. (2012) using data for 82 countries over 1995–2008 uncovered different results. They found that expanding

[11] According to their summary, 28 causes of corruption are inefficient government and political structure, civil participation, economic freedom, economic growth, ethnic diversity, gender, globalization, government size, government structure, government system, historical drivers, legal system, market and politic competition, natural resource endowment, political instability, poverty, property rights, religion, trade (openness), transparency, wages, contagion effects, economic prosperity, education, e-government, immigration and internet. And 12 consequences of corruption include bureaucratic inefficiency, business and invest environment, civil and political rights, economic growth, FDI, income inequality and poverty, international trade, political legitimacy, shadow economy, brain drain, fiscal deficit and human capital.

government size led to decreased corruption in countries with high democratic levels; conversely, expanding government size increased corruption in countries with low democratic levels. Most empirical research about corruption in China has shown negative relationships between government size and corruption.[12] For the situation in China, we use government consumption in GDP to represent government size, and postulate:

Hypothesis 1: Larger government size leads to stronger regulation of the economy which means greater room and capability to engage in rent-seeking activities, and thus, leading to higher corruption, ceteris paribus.

2.2.2 Government Decentralization

Theoretically, government decentralization can affect corruption through "competition effects" and "monitoring effects". Local governments compete to attract labor and investment through optimizing the business climate, thus motivating government to control and reduce corruption. Additionally, it is easier for citizens to monitor bureaucrats than in a decentralized government. Echazu and Bose (2008) analyze government structure, corruption and shadow economy in a theoretical model and conclude that massive corruption and shadow economy would exist in a highly centralized government. Several empirical studies also provide evidence for this. Fisman and Gatti (2002) find that fiscal decentralization reduces corruption significantly through analyzing panel data from 1980 to 1995 in 59 countries. Dell'Anno and Teobaldelli (2012) construct a framework to check the effects of decentralization on corruption and shadow economy, finding that both are negatively influenced by government decentralization. Albornoz and Cabrales (2012) assumed that decentralization would decrease corruption because civil society can detect corruption more easily, but prevention still depends on political competition among local governments, that is, the more political competition among local governments, the less corruption will be observed. However, Lessmann and Markwardt (2009) assume that

[12] Related results can be seen in Zhou and Tao (2009), Wan and Wu (2012), Luo, Duan and Hu (2015), and Deng and Sun (2018).

the influence of decentralization on corruption depends on effectiveness of social supervision. Decentralization decreases corruption if the government allows a high degree of press freedom, but if not, decentralization will play the opposite role. Goel (2011) points out that the effect of government decentralization on corruption prevention depends on the style of decentralization.

Hypothesis 2: Government decentralization decreases corruption through the "competition effect" and the "monitoring effect", ceteris paribus.

2.2.3 Wages of Public Servants

Higher wages of public employees increase the opportunity costs of corruption, because if offenses are detected, bureaucrats face losing their jobs. Hence, corruption may not be the optimal choice for the maximization of income. In addition, higher wages attract more talented staff to the public sector and prevent brain drain, thus increasing the government's ability to control corruption. To check the link between public employees' wages and corruption, Veldhuizen (2013) experimented by offering bribes to public officials, finding that 91% of low-waged public officials accepted the bribes, but only 38% of high-waged public officials accepted the bribes. Jetter, Agudelo and Hassan (2015) find that democratic institutions have a great influence on corruption. Their results show that democracy decreases corruption in countries with GDP per capita higher than US$2000 (in 2005 prices) and increases corruption significantly in poor countries. An and Kweon (2017) checked the effect of public servants' wages on corruption directly with cross-country data, finding that corruption would be reduced by 0.26 units when relative wages of public officials increased by 1 unit, and this effect was clearer in low-income countries. Wan and Wu (2012) point out that while raising the relative wages of public servants can reduce corruption, the difference is negligible compared with the huge benefits from rent-seeking, so it can only be a supplementary measure of anti-corruption. We think that with increased public servants' wages, the opportunity cost of corruption will increase, leading a rational public official to forego some rent-seeking opportunities. That is, higher wages can play a role in reducing

corruption and constructing a clean bureau system. So, we postulate:

Hypothesis 3: The incentive for corruption will decrease and the opportunity cost of corruption will increase with an increase in public sector wages, ceteris paribus.

2.2.4 Education

In general, higher education levels will be beneficial in reducing corruption. Better educated citizens are more capable of evaluating negative effects of corruption, have stronger awareness of defending public interest, are more responsible and more critical, which increase the costs of corruption (Eicher et al., 2009). Most highly corrupt countries lack investment in public education and human capital, so people receive less education and understand little of their government, making it more difficult for them to monitor behaviors of government and officials. In fact, corrupt governments tend to reduce spending on education, because it's harder to seek rent in education compared with other industries, such as the housing and construction industries (Mauro, 1998). Evidence can be found in empirical studies. By studying corruption in the United States, Glaeser and Saks (2004) found that with every 2.2% increase in educational attainment, the rate of corruption fell by 0.064 units, indicating a negative relationship between education and corruption. Dreher et al. (2007) note that with increasing education levels, people's awareness of government supervision and their anti-corruption consciousness will be strengthened. Truex (2011) investigated in Nepal and found that more educated interviewees expressed lower acceptance of corruption, however, when referring to specific corrupt practices, this effect was more obvious in grand corruption than petty corruption. Bosco (2004) argues that talented people prefer rent-seeking rather than producing, so education cultivated their ability to undertake corrupt practices. Although there are different opinions on this issue, we believe that, generally speaking, improving the overall education level of citizens is conducive to reducing corruption.

Hypothesis 4: More education leads to lower corruption because more educated citizens have a stronger willingness and ability to supervise bureaucrats, and more educated officials have more incentive to refuse corruption, ceteris paribus.

2.2.5 Rule of Law

Transparency International (TI) postulates strengthening law enforcement as the core strategy for anti-corruption, and police forces, prosecution services and courts are the most important institutions for law enforcement (Fijnaut, 2002). The rule of law can limit corruption through two aspects, the "protection effect" and "deterrence effect". On the one hand, a good legal system always places more attention on protecting property rights, prompting government transparency which will limit bureaucrats' corruption; on the other hand, corrupt behaviors can always be found and punished in countries with stronger law enforcement and effective judicial systems (Nwabuzor, 2005). We expect that a worse legal system may result in even more corruption due to probable corruption of legal enforcers. Police officers may accept bribes from corrupt bureaucrats in return for shielding their offenses, which will dilute the deterrent effect of law enforcement. They may even extort and frame innocent officials for rent-seeking, which will directly increase corruption (Polinsky and Shavell, 2001). Sundström (2015) conducted an experiment in the fish industry in South Africa, finding that inspectors received bribes from fishermen in return for inadequate enforcement and information sharing, demonstrating that inefficient law enforcement was related to high corruption. Dong and Torgler (2013) showed a negative correlation between the strength of anti-corruption and corruption in China.

Hypothesis 5: In a country or region with good rule of law, more laws will be proclaimed to protect public and private interests, thus leaving less opportunity for corruption, ceteris paribus. Also, with stronger law enforcement, corruption can be deterred and punished in a timely manner, providing less space for long-term and extensive corruption, ceteris paribus.

2.2.6 Public Investment

Public investment is an area where frequent corruption occurs, mainly concentrated in infrastructure construction. Sohail and Cavill (2008) point out that construction is one

of the most corrupt industries worldwide with corruption funds of US$340 billion in 2005. Why is public investment related to high corruption? On the one hand, public investment requires great sums of money, which provides great opportunities for officials to misuse public funds if there is no effective supervision. On the other hand, many private enterprises participate in construction of public projects, and these enterprises often bribe public officials in obtaining bids and evading supervision (Kenny, 2007). Godden and Picci (2005) found a significant positive relationship between corruption and public works in Italy, and further analysis indicated that the incidence of corruption in public works declined after Italy strengthened legal supervision and enforcement in this field. In addition, some researchers consider public investment a consequence of corruption because corruption encourages public officials to enlarge the scale of public investment to get more opportunities for rent-seeking. It also leads to more investment in fields where it is easier to seek rent, such as traffic construction and public building construction (Croix and Delavallade, 2008). After analyzing 58 countries' data, Haque and Kneller (2008) found that corruption led to increased public investment but also resulted in much ineffective investment, reducing the pull effects of public investment on economic growth. Hence, we postulate:

Hypothesis 6: Public investment leads to more corruption, especially in countries or regions without effective supervision, ceteris paribus.

2.2.7 Media supervision

Media plays a very important role in monitoring governments, and is even called "the fourth sector" or "the king without a crown in politics". Media supervision can affect corruption through its "detection effect" and "deterrence effect". The media makes it more difficult for bureaucrats to conceal corrupt behaviors because corruption information can spread widely and attract attention, making it easier for anti-corruption departments to detect corrupt behaviors. On the other hand, corrupt officials face more costs after their illegal actions are detected, such as reputation loss and increased difficulty to find a new job, so may think twice before behaving corruptly. According

to a recent report on public opinion in China, corruption accounts for 6.5% of internet hot events (Zhu et al., 2016). Jarso (2010) thinks that media freedom represents the freedom to express and obtain information, which are crucial factors in building transparent government. He introduces the experience of Kenya and finds that the media always plays the role of "whistle blower". Bertot et al. (2010) suggest constructing transparent government with Information and Communication Technologies (ICTs), because ICTs shorten the distance between government and citizens, strengthening supervision of public employees and reducing corruption. We use the proportion of staff in news media, radio, and the film and television industries, compared to public servants, as a proxy for media supervision intensity, and postulate:

Hypothesis 7: Media supervision reduces corruption, ceteris paribus.

2.2.8 Government Procurement (Government Transparency)

The traditional view is that government procurement brings more corruption. As bureaucrats often have selfish interests, they may distort bidding rules and distribute contracts to those who pay rent or bribes (Auriol et al., 2016). The "prisoner's dilemma" among tenderers is also an important driving force for corruption in public procurement. Bidders assume that others will bribe the government, so to get the contract, they must send rent to bureaucrats even though the bribery may increase the firm's costs and damage its reputation (Søreide, 2002; Büchner et al., 2008). Once enterprises and bureaucrats have achieved conspiracy, the following measures may be used in public procurement corruption: poor advertisement, a short bidding period, poor specifications, nondisclosure of selection criteria, award of contract by lottery, and one-sided contract documents (Mahmood, 2010). To curb corruption in public procurement, many countries have improved transparency and strengthened supervision in public procurement processes. The "Government Procurement Agreement" announced by the WTO provides an effective framework and guiding principles to improve transparency and normalize public procurement procedures. China also has several acts on public procurement. These acts stipulate the principles,

methods, procedures, supervision and punishment mechanisms of public procurement.[13] In addition, the internet has been indispensable in publishing procurement planning, specific project information, bidding procedures and winning bidders, hence e-procurement is valuable in improving transparency and supervision of public procurement (Neupane, 2012). Public procurement by auction is the most open and transparent method in government consumption, so if we regard the proportion of government procurement in total government consumption as the size of government procurement, then we can postulate:

Hypothesis 8: The larger the government procurement, the higher the transparency of government, the less corruption, ceteris paribus.

2.3 What are the indicators of corruption?

In the existing literature, numerous consequences or indicators of corruption have been explored, such as economic growth, the income gap, foreign direct investment, fiscal expenditure structure and lower public invest efficiency (Dreher et al., 2007; Dimant and Tosato, 2017). Our paper focuses on effects of corruption on economic growth, official income of residents, income gap and FDI flows.

2.3.1 Indicator 1: Corruption Cases Detected by Judicial System

The most obvious indicator variable of corruption is the amount of corruption cases detected by judicial departments. The number of corruption cases is regarded as an indicator to measure the corruption extent of a country or region.[14] Some critics argue that it depends on the efficiency of the judicial system and intensity of law enforcement, however, we can suppose that these factors are homogeneous in the same country. Compared with other indicators, it is interfered with by other factors to the least extent. Although it only reflects part of corruption, there is a positive correlation between detected corruption cases and corruption extent, so we will select detected corruption cases as the benchmark indicator variable in the MIMIC model.

[13] Source: the website of China Government Procurement, http://www.ccgp.gov.cn/.

[14] We concluded this in detail in 2.1 which introduced how to measure corruption using an objective method.

Hypothesis 9: The amount of corruption cases detected by the judicial department will increase when there is more corruption, ceteris paribus.

2.3.2 Indicator 2: Economic Development

Is corruption sand or grease to the wheel of economic development? We can find supporting evidence for each view. The mainstream view is that corruption sands the wheel of economic development mainly through increasing uncertainty and costs of business activities, decreasing investment, distorting resource allocation, reducing production efficiency and causing brain drain (Campos etc., 2010; Yakautsava, 2011). Mauro (1997) employed an empirical approach to analyze the impact of corruption on investment, finding that corruption had a significantly negative impact on investment ratio (the share of investment in GDP), indicating that corruption reduced investment and thus hindered economic growth. Mabolaji and Omoteso (2009) provide evidence for the sand view, analyzing transition countries. Brempong and Camacho (2006) showed different effects of corruption on economic growth in different world regions. Specifically, when the corruption level falls by 10% there will be an increase of 1.7% in the growth rate of income in OECD and Asian countries, an increase of 2.6% in Latin American countries and an increase of 2.8% in African countries. Evrensel (2009) investigated the effects of corruption on the volatility of economic growth, showing significant negative correlation between corruption and economic volatility.

Compared to sufficient evidence of the sand hypothesis,[15] evidence for the "grease hypothesis" is scarce. Leff (1964) found that corruption increased the efficiency of resource allocation and market efficiency in highly corrupt regions, thus corruption played the role of grease in economic development. Powell, Manish and Nair (2010) surveyed the effects of corruption and crime on economic growth through a literature analysis and found that corruption promoted economic growth in regions with strong regulation and red tape. Analyzing firms in Vietnam, Nguyen and Dijk (2012)

[15] More evidences for the "sand effect" of corruption on economic development can be seen in Guetat (2006), Akai etc. (2005), Meon and Sekkat (2005), Aidt (2009), Johnson et al. (2011) and many other related studies.

documented that corruption reduced development of private enterprise, however, there was a positive relationship between corruption and benefits to state-owned enterprises. Swaleheen and Stansel (2007) declared that the effects of corruption on economic growth depended whether it decreased market competition and regulation. In countries with low economic freedom, corruption hinders economic growth through reducing competition in the market, however, it promotes economic development in high economic freedom countries through expanding free exchange. We conclude that, even for studies which support the grease hypothesis, the positive effects of corruption on economic growth only exist in limited countries and regions, such as countries with a high extent of corruption or countries with high intensity of regulation. Yang and Zhao (2004) showed that administrative corruption in China lowered the economic growth rate and wasted public expenditure. We can postulate:

Hypothesis 10: Corruption deteriorates the climate for economic development by adding uncertainty, political instability and other extra costs, thus hindering economic development, ceteris paribus.

2.3.3 Indicator 3: Official Income of Residents

Theoretically, corruption will affect the official income of residents through hindering formal economic development and enlarging shadow income. Several studies support this view. Through analyzing cross-country data for Africa, Brempong (2002) found that corruption decreased average income by reducing investment and the productive efficiency of resources. Achim (2017) considers corruption a poverty-driving virus because it hinders business prosperity and decreases investment, leading to more unemployment. After analyzing micro-survey data from Bangladesh's agricultural sector, Islam and Lee (2016) found that corruption had a significant negative effect on income. On the one hand, higher corruption means more regulation and worse institutional quality. To avoid regulation costs and bribery costs, firms and workers will choose to shield their produce and income (Choi and Thum, 2005; Ruge, 2010). On the other hand, in most cases, shadow economy is related to illegal activities. Shadow firms

and laborers have to bribe bureaucrats to avoid being detected and punished, which will decrease their income (Buehn and Schneider, 2012; Geol and Saunoris, 2014). Bureaucrats also need to shield their corrupt gains to escape judicial detection. Shadow economy activities bring about tax evasion and threaten financial safety, increasing the instability of society, so that civilians' employment and income can't be guaranteed (Fernández and Velasco, 2014). Therefore we postulate:

Hypothesis 11: Higher corruption will decrease the official income of residents through hindering the development of formal economy and enlarging shadow income, ceteris paribus.

2.3.4 Indicator 4: Income Inequality

It is generally believed that corruption increases income inequality. Bureaucrats, especially senior officials, have more opportunities to obtain illegal income through embezzlement, bribery and other corrupt practices. In a corrupt society, high income earners have greater energy to acquire more resources and evade regulations through bribing officials. However, compared with high-income earners, low-income earners have to spend a larger proportion of their income to pay bribes, so income inequality is further increased.[16] Evidence from Africa shows that corruption decreased overall economic levels, and the poor suffered more income loss, leading to more income inequality (Brempong, 2001). Apergis et al. (2010) report that corruption enlarges income inequality in the US significantly, and there is bidirectional causality between corruption and inequality in the US in both the short-run and long-run. Specifically, Dincer and Gunalp (2011) obtain similar findings for the US, demonstrating that when the number of public servants involved in corruption increased by 1 percent, the Gini coefficient increased by 0.068 unit. Different results are found for Latin America. Dobson and Andres (2010) find that corruption has a significant negative effect on income inequality. They attribute this to the large shadow economy in Latin Africa because corruption leads to more informal jobs for those who can't get a job in the

[16] Elaboration of the channels through which corruption affect income inequality also can be seen in Dincer and Gunalp (2011).

formal sector. Ramlogan-Dobson (2012) verifies this finding, again using cross-country data for Latin America, and concludes that shadow economy plays an important role in the link between corruption and income inequality, hence, government should also decrease the shadow economy when striving against corruption. In addition, evidence from Wu and Zhu (2012), Xue and He (2012), Sun (2014), Zhang and Yang (2015) all found corruption enlarged the income gap between urban and rural residents in China. We postulate:

Hypothesis 12: Corruption aggravates the extent of income inequality in China's provinces and municipalities, ceteris paribus.

2.3.5 Indicator 5: FDI Inflow

FDI plays an important role in the development of countries and regions. Like the relationship between corruption and economic development, there are two sides in the relation between corruption and FDI, the grease hypothesis and the sand hypothesis. The mainstream view is that corruption will increase the costs and uncertainty of investment, so foreign investors will be more hesitant about investing in regions with higher corruption. Al-Sadig (2009) explored the correlation between corruption and FDI flows using data for 117 countries and found that inflows of FDI dropped by 11% when there was a 1 unit increase in corruption in host countries. Reiter and Steensma (2010) claim that corruption not only decreases the inflow of FDI, but also hinders the positive effects of FDI in promoting local economic development. Helmy (2013) and Liao and Xia (2015) claim that FDI prefers to flow into highly corrupt regions to evade environmental regulation through bribing bureaucrats, causing China to become a "pollution paradise". Asiedu and Freeman (2009) analyzed the effects of corruption on FDI flows using firm-level data and found that corruption decreased inflows of FDI in transition countries, but no evidence was found for Latin America or Sub-Saharan Africa. We postulate:

Hypothesis 13: Corruption increases the uncertainty and extra costs of investment, thus leading to a decrease in FDI inflow, ceteris paribus.

3. Analysis of the Extent of Corruption in China's Provinces Using a MIMIC Model

The MIMIC model is a special method to measure unobservable variables, taking causes and consequences into account. We chose a MIMIC model to measure corruption in China's provinces. We then calculated the corruption index of each province for each year, which can be compared horizontally and vertically. The structural equation model has been applied widely in estimating the size of the shadow economy,[17] but when it comes to measuring the corruption extent of different regions in a country, its research achievements have been limited.

3.1 Model and Variables

In part 2 we described the eight determinants and five indicators of corruption; these have been included in our MIMIC model.[18] All variables and their hypothetical relationship with corruption are presented in Figure 3.1.1.

Considering the situation of China and availability of data, we chose the following causal variables:

(1) use government consumption (GOVC) to represent government size;

(2) use fiscal expenditure decentralization (FED) to represent government decentralization;

(3) use the level of higher education (EDUH) to reflect the education level;

(4) use the relative wage of public servants (WAGE) to represent wages;

(5) use the expenditure of judicial departments (LAW) to capture the intensity of law enforcement;

(6) use investment by state-owned assets (PUBINV) to capture the size of public

[17] The MIMIC model has been applied widely in estimation of shadow economy, and detailed elaboration of MIMIC's principles and usage can also be found in Buehn and Schneider (2009), Buehn and Schneider (2012) Schneider et al. (2016), Medina and Schneider (2017).

[18] As we can only obtain data on government procurement for 2001–2013, we can't take it into account in the estimation model over 1995–2015. An extra regression is made to check its effects on corruption.

investment;

(7) use the ratio of employees in news and media industry to employees in public sector (MEDIA) to represent the intensity of media supervision;

(8) set a dummy variable (PCON) for the four provinces directly under the control of the central government to capture the intensity of political control.[19]

The indicator variables are:

corruption cases per 10000 public servants (CORCASE),

GDP per capita (GDPPC) or income per capita (INCPC),[20]

income inequality between urban and rural residents (INEUR),

FDI inflow (FDI) as indicator variables.

In addition, we adjust the form of some variables, namely, using the natural logarithm of PUBINV (LnPUBINV), GDPPC (LnGDPPC), INCPC (LnINCPC) and FDI (LnFDI), and the first difference value of MEDIA (D.MEDIA) and INEUR (D.INEUR) in our model.[21]

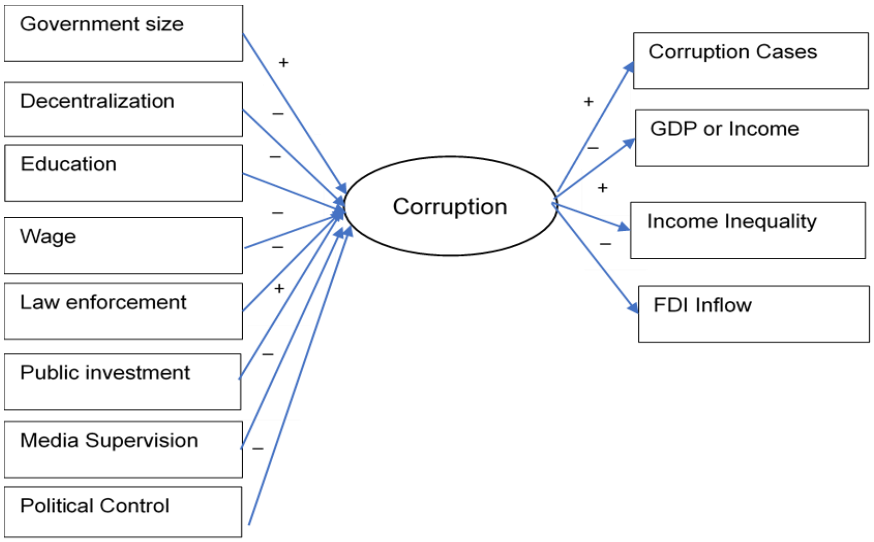


Figure 3.1.1 MIMIC path route for estimating China's corruption

[19] Beijing, Shanghai, Tianjin and Chongqing are the four municipalities directly under the central government.

[20] We can only select one of GDP per capita or income per capita in the same model because they are highly correlated.

[21] The definition, description statistics and sources of all variables are presented in Appendix A1.

Setting corruption (COR) as the unobservable latent variable, we can construct the following MIMIC model:

Structural model:

$$COR = \beta_1 GOVC + \beta_2 FED + \beta_3 EDUH + \beta_4 WAGE + \beta_5 LAW + \beta_6 LnPUBINV + \beta_7 D.MEDIA + \beta_8 PCON + \mu \quad (6)$$

Measurement model:

$CORCASE = \beta_9 COR + \varepsilon_1$ (7); $LnGDPPC = \beta_{10} COR + \varepsilon_2$ (8)

$LnINCPC = \beta_{11} COR + \varepsilon_3$ (9);[22] $D.INEUR = \beta_{12} COR + \varepsilon_4$ (10)

$LnFDI = \beta_{13} COR + \varepsilon_5$ (11)

Generally, to make the MIMIC method more suitable to panel data, we should import the data into the model as deviations from the mean value of each province.[23] Hence, data for all variables should be transferred to following structure:

$$X_{jit}^* = (X_{jit} - X_{ji}); \qquad Y_{jit}^* = (Y_{jit} - Y_{ji}) \qquad (12)$$

Where j=1, 2, 3, ….,13 indicates the observable variables, i=1, 2, 3, ….., 30 indicates 30 provinces of China, and t=1995, 1996, ….., 2015 indicates the time period.

3.2 Empirical results of China's provincial corruption using the MIMIC Model

Now, we undertake the MIMIC estimation of corruption in 30 provinces over 1995–2015. The most important results are shown in Table 3.2.1.

We report five models in Table 3.2.1., which are to some extent the best ones. Comparing the results we get two models which fit well, namely Model 3-4 and Model 3-5. When considering the causal variables, we find that all causal variables are statistically significant and have the predictive effects we hypothesized in part 2. However, the effects of fiscal expenditure decentralization (FED) are not significant in

[22] Formula 8 and formula 9 can't exist at the same time, and we can only choose one of the two formulas in the same model.

[23] Dell'Allo and Mourao (2012), Dell'Allo and Dollery (2014) elaborated this in detail, and they pointed out that it considered deviations from the (overall) mean to calculate the matrixes of covariances.

Model 3-5. What's more, compared with residents' official income, we think that corruption can affect economic development more directly. Hence, we prefer Model 3-4 to estimate the corruption of China's provinces, but the results from Model 3-5 can be used to make a comparison with Model 3-4 to check its robustness.

Table 3.2.1 MIMIC Regression Results of China's Corruption

	M 3-1	M 3-2	M 3-3	M 3-4	M 3-5
Causal variables					
GOVC	0.1057 (4.6) *** 0.0689	0.1054 (4.59) *** 0.0706	0.1002 (4.45) *** 0.0672	0.1049; (4.58) *** 0.0684	0.0597 (2.53) ** 0.0389
FED	-0.0116 (-3.29) *** -0.0481	-0.0117 (-3.41)*** -0.0501	-0.0130 (-2.95)*** -0.0554	-0.0116; (-3.38)** -0.0482	0.0002 (0.06) 0.0009
EDUH	-3.8407 (-15.12) *** -0.5831	-3.8375 (-15.11) *** -0.5989	-3.6819 (-14.69) *** -0.5746	-3.8349; (-15.11) *** -0.5824	-3.6966 (-14.6) *** -0.5615
WAGE	-1.4799 (-3.27) *** -0.0406	-1.4721 (-3.26) *** -0.0415	-1.3012 (-2.95) *** -0.0367	-1.4554; (-3.23) *** -0.0399	-2.1359 (-4.45) *** -0.0586
LAW	-1.6892 (-8.81) *** -0.2030	-1.6852 (-8.83) *** -0.2082	-1.6345 (-8.66) *** -0.2019	-1.6893; (-8.85) *** -0.2031	-1.8396 (-9.12) *** -0.2212
LnPUBINV	3.9355 (11.21) *** 0.2949	3.9420 (11.24) *** 0.3036	3.9106 (11.05) *** 0.3012	3.9425; (11.24) *** 0.2955	4.1201 (11.22)*** 0.3089
D.MEDIA	-0.1482 (-2.83)** -0.0355	-0.1479 (-2.82)*** -0.0344	-0.1441 (-2.8)*** -0.0334	-0.1490; (-2.85)*** -0.0377	-0.1124 (-2.05) ** -0.0254
PCON	-4.0484 (-4.96)*** -0.0605	-4.0475 (-4.96)*** -0.0622	-3.9050 (-4.86)*** -0.0600	-4.0515 (-4.96)*** -0.0606	-5.3074 (-6.08)*** -0.0794
Indicators					
CORCASE	1	1	1	1	1
LnGDPPC	-0.1400 (-18.46) ***	-0.1401 (-18.44) ***	-0.1439 (-18.09) ***	-0.1401 (-18.43) ***	
LnINCPC					-0.1230 (-18.55)***
D.INEUR	0.0064 (4.54) ***	0.0064 (4.455)***			

LnFDI	-0.1161 (-15.24) ***		-0.1215 (-14.94)***		
Model Fitting statistics					
Chi-square (p)	93.744 (0.000)	58.7 (0.000)	55.33 (0.000)	9.406 (0.225)	9.687 (0.207)
RMSEA	0.070	0.068	0.062	0.023	0.025
CFI	0.971	0.977	0.983	0.998	0.999
TFI	0.952	0.959	0.972	0.997	0.996
SRMR	0.035	0.034	0.016	0.010	0.010
N	630	630	630	630	630

Notes:1. The regression is made by Stata 14.0，and regression coefficient, statistic z and beta coefficient of causal variables are reported in the table. *, **and *** respectively represent significance at confidence levels of 10%, 5% and 1%.

2. The model fits well when p is bigger than 0.05 (1 is perfect), Approximate Error Root Mean Square (RMSEA) less than 0.05, Comparative fit index (CFI) bigger than 0.9, Tucker-Lewis index bigger than 0.95 and Standardized Residual Mean Square Root (SRMR) less than 0.05.

Source: our calculation.

As shown in Model 3-4, the amounts of government consumption and public investment both have significant effects on corruption. It demonstrates that the more financial funds are used for government consumption and public investment, the more intervention and discretion the government has on economy and society, and there will be more opportunities for corruption. Specifically, when the percentage of government consumption in GDP increases by 1, corruption will increase by 0.1049 units, and when the percentage of public investment in GDP increases by 1, the corruption extent will increase by 3.9425 units. The other six variables all have significant negative effects on corruption. When the percentage of local per capita fiscal expenditure in national per capita fiscal expenditure increases by 1, the corruption extent decreases 0.0116 units. This is because higher decentralization can shorten the distance between government and citizens, and people know more about government behaviors such as government revenue and expenditure decisions, which is conducive to enhancing government transparency and public supervision. When the percentage of students studying in colleges and universities to total population increases by 1, corruption decreases 3.8349 units. This is mainly because citizens' consciousness of supervising officials and boycotting corruption is stronger when they are more educated. Besides, when the ratio

of the average wage of public servants to regional average wage increases by 1, corruption decreases 1.4554 units. The reason is that higher relative wages of civil servants can decrease their incentive to be corrupt. In addition, considering the function of internal supervision and external supervision, the results show that law enforcement and media supervision both have significant negative effects on corruption. When the percentage of expenditure of judicial branches in total fiscal expenditure increases by 1, corruption decreases 1.6893 units; when the percentage of employees in the media industry compared to numbers of public servants increases by 1, corruption decreases by 0.1490 unit. Considering the effects of political control from central government, the results demonstrate that the extent of corruption in provinces and municipalities directly under the central government is 4.0515 units lower than in other provinces, which is mainly because these districts receive stronger political control and supervision from the central government. Finally, setting detected corruption cases as the benchmark indicator, we find that per capita GDP will decrease by 0.14 percent when the extent of corruption increases by 1 unit. Model 3-5 shows that residents' income will decrease by 0.123 percent when corruption increases by 1 unit. As for the other two indicator variables, results from Model 3-2 and Model 3-3 demonstrate that increased corruption will enlarge income inequality and decrease FDI significantly in statistics.[24]

To compare the effects of the eight causal variables, we also report their standardized regression coefficients. Through comparing beta coefficients, we realize that education is the most important factor in decreasing corruption and public investment is the most important factor resulting in increased corruption. Since China's anti-corruption activities mainly rely on internal supervision, law enforcement has become the factor only behind education for decreasing corruption. In order of importance, the remaining casual factors are political control, government size, wages, media supervision and government decentralization.

[24] Although neither Model 2 nor Model 3 fit well, they still illustrate the relationship between corruption and income inequality, corruption and FDI to a certain extent.

4. Estimating the corruption index of China's provinces

Although all variables have been transferred to the deviation of the original data from disaggregated mean value of each province, we can still use the following formula to estimate disaggregated corruption indexes of China's provinces according to the method explored by Dell'Anno and Mourao (2011)[25]:

$$COR = 0.1049*GOVC - 0.0116*FED - 3.8349EDUH - 1.4544*WAGE - 1.6893*LAW + 3.9425*LnPUBINV - 0.1490*D.MEDIA - 4.0515*PCON \quad (13)$$

The next step is to normalize the index to the range of [0,10][26]. Here, we apply the same method used by Dell'Anno and Dollery (2014), which obeys the following formula:

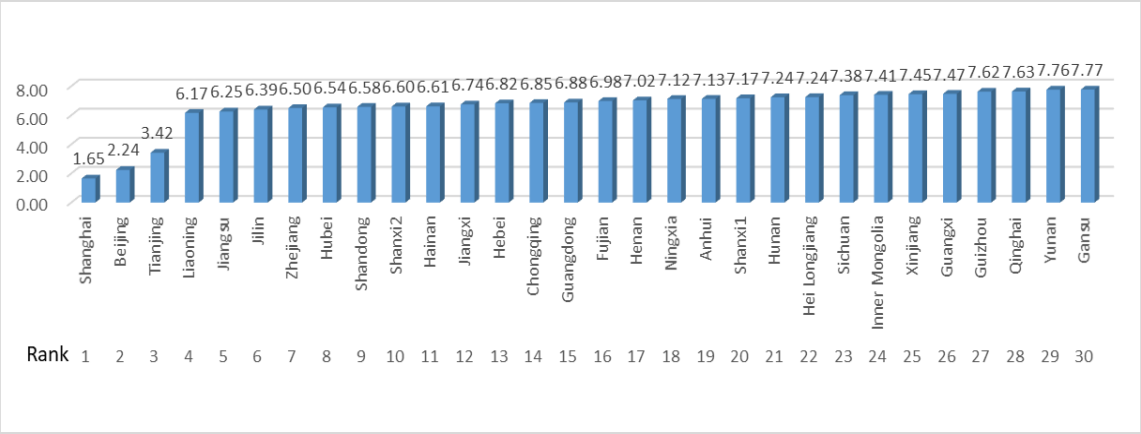
$$COR_{it}^{*} = 10 \times \frac{COR_{it} - \min_{\forall i, \forall t}(COR_{it})}{\max_{\forall i, \forall t}(COR_{it}) - \min_{\forall i, \forall t}(COR_{it})} \quad (14)$$

Now, finally, we can obtain the disaggregated corruption index of each province per year. The specific values are presented in Appendix C1.

Figure 4.1 Average value of corruption index over 1995–2015 for each province

[25] In research measuring the fiscal illusion index all over the world, Dell'Anno and Mourao (2011) illustrated that the structure of the MIMIC model can be expressed as: $(F_{it} - \bar{F}_{it}) = \beta_1(XI_{it} - \bar{XI}_{it}) + \beta_2(X2_{it} - \bar{X2}_{it}) + \beta_3(X3_{it} - \bar{X3}_{it}) + \beta_4(X4_{it} - \bar{X4}_{it}) + \beta_5(X5_{it} - \bar{X5}_{it}) + \varepsilon_6$, which can be expressed as the difference of the following formulas: $F_{it} = \beta_1 XI_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + \beta_5 X5_{it}$ and $\bar{F}_{it} = \beta_1 \bar{XI}_{it} + \beta_2 \bar{X2}_{it} + \beta_3 \bar{X3}_{it} + \beta_4 \bar{X4}_{it} + \beta_5 \bar{X5}_{it}$. F_{it} is the latent variable, $\bar{F}_{it}$ is the mean value of the latent variable, i represents countries and t is the time variable.

[26] A higher index value means more corruption. In addition, the corruption index only provides a perspective to compare corruption extent across different periods and regions, so the value of the index represents a relative value, not an absolute value. That is, 0 means the minimum corruption level rather than no corruption at all and 10 means the maximum corruption level rather than complete corruption.



Notes: 1. The bigger the value, the higher the ranking, which means more corruption.
2.Shanghai, Beijing and Tianjin are under much stricter political control because of their special status, so the values for these 3 districts are much lower than other provinces.[27]
Data source: our calculation.

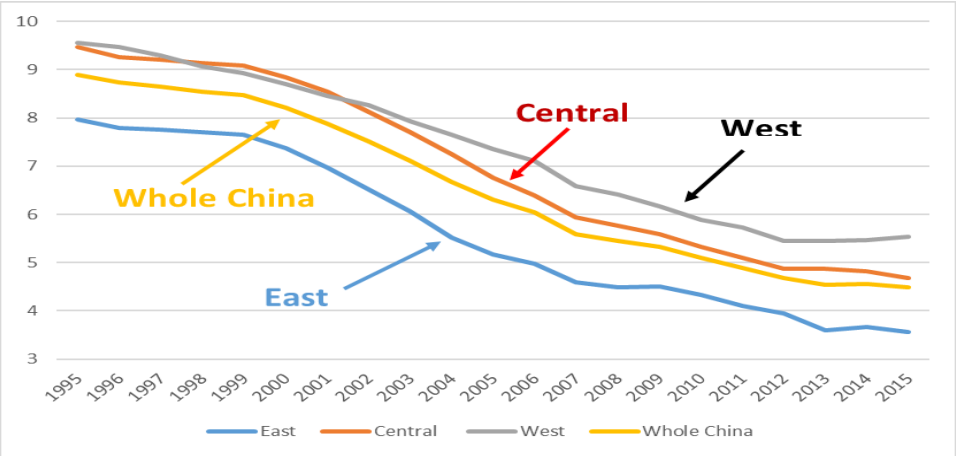
Figure 4.1 presents the average value of the corruption index over 1995–2015 in each province. As shown in the figure, the average value in most provinces lies between 6 and 8 and the average value for the whole of China is 6.23. However, the average values for Beijing, Tianjin and Shanghai are much lower than in other provinces which means there is less corruption in these provinces, and the lowest value of only 1.65 appears in Shanghai. These three provinces are all under direct control of the central government. On the one hand, these three provinces will receive more supervision from the central government because of their special status, on the other hand, the leaders of these three districts have great potential to be promoted to the central government and become some of the most important leaders in the Chinese Communist Party and Chinese government. So, considering their political future, the leaders of these districts will pay more attention to anti-corruption policies. Additionally, and compared with other provinces, they all rank highly in economic level, education, openness and government transparency. Considering the most corrupt provinces, we find that the average values of the corruption index in Gansu, Yunnan and Qinghai are higher than in other provinces. The average value in Gansu is the highest at 7.77. These three provinces are in the western districts of China, and levels of economy, education and openness in these

[27] Shanghai is the economic center of China, Beijing is the capital of China, Tianjin is close to Beijing and all of them are municipalities directly under the central government. Appendix D presents the results without political control.

provinces lag behind other provinces.

Figure 4.2 presents corruption extent in different regions over 1995–2015. It's clear that corruption in all three regions shows a downward trend, which means that China has made some achievements in anti-corruption with the development of economy, education, law and improved supervision systems. Besides, the different corruption levels in different regions reflects that the more developed the economy, the smaller the scale of corruption; conversely, the more backward the economy, the larger the scale of corruption. The results are consistent with the scores and rankings of the Corruption Perceptions Index published by Transparency International, which also demonstrates that there is less corruption in developed countries and regions, and conversely, that corruption in some developing countries is extremely serious.

Figure 4.2 Corruption in different districts of China



Data source: our calculation.

5. Robustness Check of the MIMIC Results

As shown in Table 5.1, to check the robustness of Model 3-4, we use the variable fiscal revenue decentralization (FRD) to replace fiscal expenditure decentralization (FED) and use the variable of average education years (EDUY) to replace higher education level (EDUH). We replace both variables at the same time in Model 5-1, only replace FED in Model 5-2 and only replace EDUH in Model 5-3. The regression results show

that all causal variables have the same sign as we expected in these three models and Model 5-2 still fits very well. However, when replacing higher education levels (EDUH) with average education years (EDUY) in Model 5-1 and Model 5-3, the degree of fit gets worse. This may be because people who have received higher education are less tolerant of corruption than others.

Table 5.1 Robustness Check of the Estimation Model

	M 5-1	**M 5-2**	**M 5-3**	**M 5-4**	**M 5-5**
Causal variables					
GOVC	0.1591 (7.99) ***	0.1219 (5.41) ***	0.1556 (7.58) ***	0.1037 (4.62)***	
FED			-0.0085 (-2.86)***	-0.0064 (-1.88)*	
FRD	-0.0151 (-3.96)***	-0.0082 (-1.84)*			-0.0155 (-1.42)
EDUH		-3.8220 (-15.04)***		-3.5424 (-14.78)***	
EDUY	-3.1588 (-17.66)***		-3.1680 (-18.49) ***		
WAGE	-0.4748 (-1.25)	-1.5815 (-3.47) ***	-0.5424 (-1.41)	-1.3729 (-3.12)***	-2.5258 (-1.86)*
LAW	-1.3979 (-9.23)***	-1.9240 (-10.55) ***	-1.2814 (-7.93) ***	-1.7676 (-9.38) ***	-4.2509 (-10.3)***
LnPUBINV	3.8265 (12.25) ***	3.9723 (11.20) ***	3.8271 (12.55) ***	3.4766 (10.30)***	9.2314 (10.18)***
D.MEDIA	-0.0237 (-0.35)	-0.1544 (-2.93)***	-0.0191 (-0.42)	-0.1505 (-2.93)***	-0.0966 (-0.81)
PCON	-0.6393 (-0.95)	-4.0681 (-4.94)***	-0.6773 (-0.99)		
LnFDI				-0.7233 (-7.18)***	
GOVP					-0.2307 (-8.14)***
Indicators					
CORCASE	1	1	1	1	1
LnGDPPC	-0.1516 (-21.36) ***	-0.1399 (-18.45) ***	-0.1503 (-23.19) ***	-0.1395 (-18.55)***	-0.085 (-18.1)***
Model Fitting statistics					

Chi-square (p)	14.476 (0.043)	9.082 (0.247)	15.574 (0.029)	10.625 (0.156)	30.167 (0.000)
RMSEA	0.041	0.022	0.044	0.029	0.114
CFI	0.996	0.999	0.996	0.998	0.973
TFI	0.991	0.997	0.989	0.995	0.930
SRMR	0.009	0.009	0.009	0.010	0.022
N	630	630	630	630	390

Notes:1. The regression is made by Stata 14.0，and regression coefficient and statistic z are reported in the table. *, **and *** respectively represent significance at confidence levels of 10%, 5% and 1%.

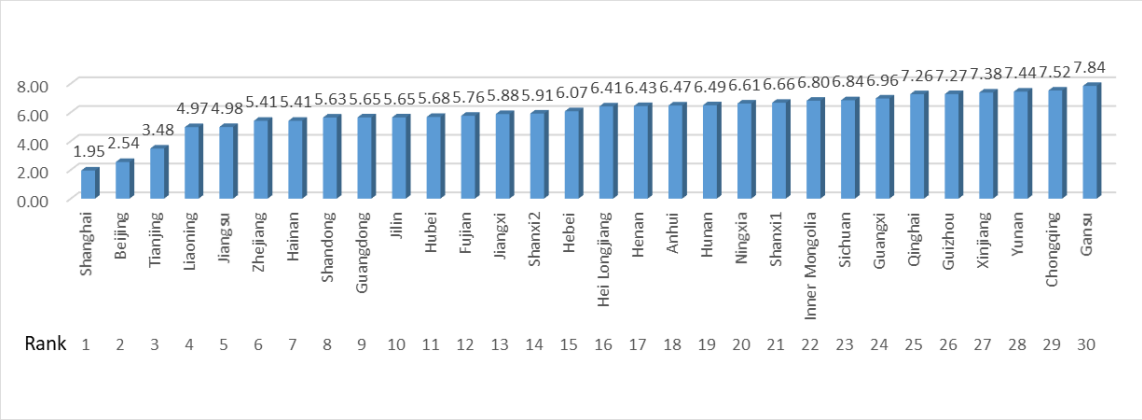
2.The model fits well when p is bigger than 0.05 (1 is perfect), Approximate Error Root Mean Square (RMSEA) less than 0.05, Comparative fit index (CFI) bigger than 0.9, Tucker-Lewis index bigger than 0.95 and Standardized Residual Mean Square Root (SRMR) less than 0.05.

Source: our calculation.

In addition, in some studies, FDI is also regarded as a causal factor of corruption,[28] so we set LnFDI as a causal factor to capture the openness of each province in Model 5-4. The regression result shows that Model 5-4 fits well and all variables have significant effects on corruption as expected. Remarkably, when FDI increases by 1 percent, the corruption extent decreases by 0.7592. The reasons mainly concentrate on two aspects. On the one hand, more open districts have more FDI, and citizens are more willing to accept knowledge and advanced values; as a result, they will be less tolerant of corruption. On the other hand, FDI has played an important role in promoting economic development over the past few decades in China, so in order to attract more FDI, local governments try to optimize the economic climate by decreasing corruption and improving institutional quality. Figure 5.1 presents the average value of the corruption index in each province, considering LnFDI as one of the causal variables. Shanghai, Beijing and Tianjin still are the cleanest provinces in China, however, Chongqing becomes the second most corrupt province after Gansu.

Figure 5.1 Corruption index calculated by Model 5-4

[28] Tadesse (2006) and Anokhin and Schulze (2009) both found that more FDI is beneficial to decrease corruption.



Note: The bigger the value, the higher the ranking, the more the corruption.
Data source: our calculation.

Finally, we explore a MIMIC model to check the effect of government procurement (GOVP) on corruption over the period 2001 to 2013. As shown in Model 5-5, GOVP has a significantly negative effect on corruption, which is consistent with our theoretical analysis. Although the fitting degree of Model 5-5 is not so good, it still shows to a certain extent that improving the proportion of government procurement in government consumption will be helpful in improving government transparency and reducing corruption.

Up to now, we have four models which fit well, namely Model 3-4, Model 3-5, Model 5-2 and Model 5-4. However, as presented in Figure 4.1 and Figure 5.1, there are still some differences among results from different models. To check the robustness of the estimation result, we need to check the correlation of results from these four models. Fortunately, all the results are highly correlated with each other, which provides strong evidence for the robustness check of our estimation result. However, when compared with the variable of corruption cases (Corcase) detected by judicial departments, we only get a correlation of 0.3932 with the result of Model 3-4. This is because corruption cases detected by the legal system only reflect a small part of corruption, moreover, many corrupt acts happened 10 years or more ago. So the variable of corruption cases detected by the legal system can't reflect the total extent of corruption in a timely and precise manner. We also collected the Corruption Perceptions Index (CPI) published by

Transparency International (TI), and checked the correlation between CPI and our results from Model 3-4, which shows a high correlation of -0.7292.[29]

Table 5.2 Correlation of different estimation results of corruption index

	M3-4	M3-5	M5-2	M5-4	Corcase
M3-4	1.0000				
M3-5	0.9937	1.0000			
M5-2	0.9987	0.9961	1.0000		
M5-4	0.9687	0.9630	0.9729	1.0000	
Corcase	0.3932	0.4017	0.3890	0.3755	1.0000

Data source: our calculation.

6. Conclusion

In this paper, we use the MIMIC approach to construct a corruption index over 1995–2015 for China's 30 provinces and analyze the determinants and consequences of corruption. We draw the following conclusions about China's corruption:

(1) Corruption is affected by several factors. As shown in estimation Model 3-4, the extent of corruption increases significantly with the expansion of government and public investment, but can be restricted by raising public servants' wages, strengthening law enforcement, promoting fiscal decentralization, expanding the scale of government procurement, increasing the education level of the general community and strengthening media supervision. Besides, by comparing the standardized regression coefficients of all causal variables in Model 3-4, we find that education level and intensity of law enforcement are most important in reducing corruption, and public investment is the most important factor contributing to increased corruption. In addition, we find that higher education plays a more significant role in preventing corruption than primary and secondary education. When considering the determinants of corruption, the regression result of Model 5-4 demonstrates that we can't rule out foreign direct

[29] The correlation ratio is negative mainly because the CPI shows higher corruption when the value gets bigger, and our index shows lower corruption when the value gets smaller.

investment as a causal variable of corruption in China's provinces.

(2) We can use corruption cases detected by judicial departments as an important indicator of corruption, but they can't reflect the total extent of corruption of a district. All models show that corruption decreases residents' official income levels significantly. In addition, although the indicator variables income inequality and FDI inflow are not included in our estimation model, we can't rule them out as consequences of China's corruption, because all models show that they have significant relationships with corruption.

(3) According to the corruption index calculated by Model 3-4, the average corruption index in China's various regions during 1995–2015 lies between 4.49 and 8.89, and shows a declining trend over this period. By comparing the situation in different districts, we find that the corruption index reaches the lowest in the eastern region, the second in the central region and the highest in the western region. The corruption index for the three regions shows the same trend change. In detail, the corruption index lies between 3.57 and 7.97 in the eastern region, 4.67 and 9.47 in the central region and 5.54 and 9.55 in the western region. Therefore, we find that China's anti-corruption actions have achieved some success. Our results show that Shanghai, Beijing and Tianjin are the "cleanest" provinces in China, and Gansu, Yunnan and Qinghai are the most corrupt provinces in China.

The results about the causes and consequences of corruption in 30 provinces of China have several policy implications for corruption prevention:

Firstly, government should reduce the inference of administrative power in economic activities, improve transparency and increase the intensity of supervision over government consumption and public investments to reduce the chance of rent-seeking and prevent officials from abusing administrative discretion for personal gain.

Secondly, government should pay more attention to improving overall education levels,

enlarge media supervision, and improve citizens' consciousness of corruption, thus increasing the probability of corruption being discovered and exerting the deterrence effects of social supervision.

Thirdly, strengthening law enforcement and increasing relative wages of public servants are also appropriate methods of decreasing corruption. On the one hand, increasing corruption costs through strengthening law enforcement, on the other hand, decreasing incentives for corruption through improving relative wages of public servants.

Finally, government should pay more attention to reducing the negative effects of corruption in the process of anti-corruption, such as promoting economic development and improving residents' income through attracting foreign capital and expanding investment, and reducing income inequality thorough reducing shadow income.

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Appendix A: A Brief Review of the MIMIC Model

According to the structure of the MIMIC model, the equation of the causes of the latent variable is called the structure model, and the equation of the consequences of corruption is called the measurement model. Thus, the MIMIC model is built as shown in formula (1) and formula (2).

Measurement model: $\boldsymbol{y} = \gamma\eta + \boldsymbol{u}$ (1)

Structure model: $\eta = \boldsymbol{\beta}'\boldsymbol{x} + \boldsymbol{\varepsilon}$ (2)

In formula (1) and formula (2), η is the latent variable, which represents corruption in this paper. $\boldsymbol{y} = (\boldsymbol{y}_1, \boldsymbol{y}_2, ..., \boldsymbol{y}_n)'$ is a set of observable indicator variables of corruption, which represents the consequences of corruption. $\gamma = (\gamma_1, \gamma_2, ..., \gamma_n)'$ represents the variation of the indicator variable after a unit of change in the latent variable. $\boldsymbol{u} = (\boldsymbol{u}_1, \boldsymbol{u}_2, ..., \boldsymbol{u}_n)'$ is an error term with a mean of zero. $\boldsymbol{x} = (\boldsymbol{x}_1, \boldsymbol{x}_2, ..., \boldsymbol{x}_k)'$ is a set of observable causal variables of corruption. $\boldsymbol{\beta} = (\boldsymbol{\beta}_1, \boldsymbol{\beta}_2, ..., \boldsymbol{\beta}_k)'$ refers to the variation in the latent variable after a unit of change for the causal variable. $\boldsymbol{\varepsilon}$ is the stochastic disturbance term.

The disturbance terms are independent of each other, and thus the indicators are affected by the common factor η. Formula (1) expresses the confirmatory factor analysis model of the observation index $\boldsymbol{y}$, the common factor η and the error $\boldsymbol{u}$. The latent variable η is determined linearly by a set of exogenous variables, namely the causal variable $\boldsymbol{x}$ and the stochastic disturbance term $\boldsymbol{\varepsilon}$. This model consists of two parts: the measurement model and the structure model. The former specifically shows how the observable endogenous variables are affected by the latent variables. The latter expresses the relationship between the latent variable and its exogenous causal variables. Because the latent variable η is unobserved, structural parameters $\boldsymbol{\beta}$ can't be

estimated directly.

After substituting formula (2) into formula (1), the MIMIC model can be regarded as a multivariate regression model in a simplified form, as shown below:

$$\boldsymbol{y} = \prod' \boldsymbol{x} + \boldsymbol{z} \qquad (3)$$

In formula (3), Π is the coefficient matrix $\gamma\beta'$ in a simplified form, $\boldsymbol{z}$ is the disturbance vector in a simplified form, and we can get $z = \gamma\varepsilon + u$. The covariance matrix of the disturbance term is demonstrated below:

$$\boldsymbol{\theta_\varepsilon} = \boldsymbol{E}[(\boldsymbol{\gamma\varepsilon} + \boldsymbol{u})(\boldsymbol{\gamma\varepsilon} + \boldsymbol{u})'] = \boldsymbol{\gamma\gamma'\sigma_\varepsilon^2} + \boldsymbol{\theta_u} \qquad (4)$$

In the formula above, θ_ε is the covariance matrix of the disturbance term $\boldsymbol{\varepsilon}$; $\boldsymbol{\theta_u}$ is the covariance matrix of the error term $\boldsymbol{u}$; σ_ε^2 is the variance of the disturbance term $\boldsymbol{\varepsilon}$. Evidently, the rank of the simplified regression matrix Π in formula (3) is equal to that in formula (1). The covariance matrix of the disturbance term θ_ε, as the sum of the single rank matrix and the diagonal matrix, is obviously equal to the rank of formula (1). Before estimating the simplified model, we need to preset one element of the vector γ to 1.[30]

The original hypothesis about the statistical quantity χ^2 in the structural equation model is $\boldsymbol{H}_0 : \boldsymbol{S} = \hat{\Sigma}$. When the maximum likelihood method is employed to estimate the model, the formula of χ^2 and F can be displayed as below:

$$\chi^2 = (\boldsymbol{n} - 1)\boldsymbol{F}(\boldsymbol{S};\hat{\Sigma})$$
$$\boldsymbol{F}(\boldsymbol{S};\hat{\Sigma}) = \boldsymbol{tr}(\boldsymbol{S}\hat{\Sigma}^{-1}) + \lg|\hat{\Sigma}| - \lg|\boldsymbol{S}| - \boldsymbol{\rho} \qquad (5)$$

In formula (5), $\boldsymbol{\rho} = \boldsymbol{p} + \boldsymbol{q}$ represents the number of the observable variables, and $\hat{\Sigma}$

[30] In estimating the model, one indicator variable should be set as a benchmark indicator for interpretation in non-standardized estimates. The indicator variable to be set is supposed to be in a positive relationship with the potential variable. For instance, if $\gamma_i = 1$, then $\boldsymbol{y_i} = \boldsymbol{\eta} + \boldsymbol{\varepsilon_i}$. If the estimation coefficient is standardized, there will be no benchmark problem.

expresses the covariance matrix of estimation samples. When the implicit covariance matrix $\hat{\Sigma}$ of the hypothetical model is in complete agreement with the S matrix of the observed data, the logarithmic value of the matrix $\hat{\Sigma}$ subtracts that of the S matrix equal to 0. Besides, $\boldsymbol{tr}(\boldsymbol{S}\hat{\Sigma}^{-1})$ turns to $\boldsymbol{tr}(\boldsymbol{I})$, equaling ρ after the substitution, so $tr(S\hat{\Sigma}^{-1})-\rho$ will be zero and we can obtain $\boldsymbol{F}(\boldsymbol{S};\hat{\Sigma})=0$ as well.

If the model is set correctly and can be recognized, we can employ the maximum likelihood method to estimate the coefficient matrix and acquire the value of the parameter vectors γ and β. If the mean value of the random disturbance term $\boldsymbol{\varepsilon}$ is 0, the order value of the potential variable $\boldsymbol{\eta}$ can be calculated based on formula (2), and thus we can obtain the corruption index required.

Appendix B Variable definitions and data

Table B1. Definition of variables

Variable		obs	Mean	Std.Dev.	Min	Max	source
Name	**Label**						
GOVC	Government consumption (government consumption in % of GDPPC)	**630**	**14.31**	**4.44**	**6.97**	**34.88**	**[1]**
FED	Fiscal expenditure decentralization (local per capita fiscal expenditure in % of national per capita fiscal expenditure)	**630**	**96.15**	**68.56**	**35.94**	**466.48**	**[1]**
FRD	Fiscal revenue decentralization (local per capita fiscal revenue in % of national per capita fiscal revenue)	**630**	**61.77**	**68.50**	**18.8**	**430.5**	**[1]**
EDUH	Higher education level (students in colleges and universities) as % of population over 6 years old	**630**	**1.16**	**0.86**	**0.04**	**3.66**	**[2]**
EDUY	Average education years	**630**	**8.05**	**1.16**	**4.69**	**12.08**	**[2]**
WAGE	Relative wage in public sector (average wage of public sector divided by average wages of all industries)	**630**	**0.93**	**0.13**	**0.57**	**1.42**	**[3]**
LAW	Strength of law enforcement (real fiscal expenditure of law system in % of real GDP, benchmark price:1994)	**630**	**1.37**	**0.68**	**0.24**	**3.74**	**[2]**
PUBINV	Public investment (investment value by SOE in % total investment)	**630**	**41.73**	**15.26**	**11.45**	**84.42**	**[2]**
MEDIA	Media supervision (employees in journalism, radio, movie and television industry in % of employees in public sector)	**630**	**10.13**	**5.77**	**3.47**	**43.59**	**[3]**
D.MEDIA	The first difference value of MEDIA	**630**	**-0.14**	**0.97**	**-3.88**	**6.72**	**o.c.**
CORCASE	Corruption cases per 10,000 public servants	**630**	**29.61**	**9.67**	**6.6**	**64.36**	**[4]**
GDPPC	Real per capita GDP (calculated in 1994 prices, Yuan)	**630**	**13860.42**	**11119.39**	**1607.17**	**68915.87**	**[2]**
INCPC	Real per capita average income (calculated in 1994 prices, Yuan)	**630**	**5827.78**	**4233.2**	**1167.29**	**25927.04**	**[2]**
FDI	Real amount of FDI per capita (calculated in 1994 prices, Yuan)	**630**	**2.85**	**0.61**	**1.6**	**4.76**	**[2]**

INEUR	Income inequality between urban residents and rural residents (income of urban residents divides income of rural residents)	**630**	**-2.85**	**0.61**	**1.6**	**4.76**	**[2]**
D.INEUR	The first difference value of INEUR	**630**	**-0.01**	**0.16**	**-0.9**	**0.65**	**o.c.**
PCON	Political control (PCON equals 1 for the four municipalities directly under the central government, and it equals 0 for other provinces)	**630**	**0.13**	**0.33**	**0**	**1**	**o.c.**
GOVP	Government procurement (government procurement / government consumption)	**390**	**1.55**	**0.94**	**0.18**	**5.25**	**[5]**

Empirical Sources:

[1] Website of National Bureau of Statistics of China, http://data.stats.gov.cn/easyquery.

[2] National Bureau of Statistics of China, Statistical Yearbook of China [M], Beijing: China Statistics Press, 1995–2015.

[3] National Bureau of Statistics of China, Labor Statistical Yearbook of China[M], Beijing: China Statistics Press, 1995–2015.

[4] The Supreme People's Procuratorate of China, Procuratorial Statistic Yearbook of China, [M]. Beijing: Chinese Procuratorial Press.

[5] Editorial board of the statistical yearbook of government procurement, Government Procurement Statistical Yearbook of China [M], Beijing: China Financial and Economic Publishing House, 2001–2013.

[o.c.] our calculation.

Appendix C Estimation Results of Corruption Index

Table C1. Estimation Results of Corruption Index of China's 30 provinces over 1995–2015

YEAR	Bei Jing	Tian Jin	He Bei	Shan Xi(1)	Inner Mongolia	Liao Ning	Jilin	Heilong Jiang	Shang Hai	Jiang Su	Zhe Jiang	An Hui	Fu Jian	Jiang Xi
1995	4.89	6.60	9.06	9.80	9.76	8.86	9.05	9.36	4.90	8.24	8.19	9.54	8.85	9.47
1996	4.84	6.27	8.81	9.72	9.55	8.65	8.90	9.30	4.42	8.26	8.13	9.12	8.73	9.27
1997	4.39	6.29	8.74	9.45	9.46	8.73	8.71	9.63	4.22	8.42	8.42	8.90	8.55	9.51
1998	4.08	6.08	8.71	9.41	9.09	8.67	8.70	9.53	4.09	8.42	8.48	8.87	8.50	9.41
1999	3.93	6.28	8.69	9.38	9.04	8.57	8.49	9.29	4.08	8.54	8.45	9.02	8.43	9.24
2000	3.42	5.47	8.53	9.14	8.95	8.19	8.23	8.78	3.52	8.26	8.41	9.00	8.23	8.91
2001	2.96	4.60	8.14	8.86	8.53	7.81	8.11	8.26	2.65	8.01	7.98	8.82	8.11	8.68
2002	1.92	4.14	7.72	8.25	8.30	7.19	7.43	7.90	1.78	7.69	7.48	8.50	8.00	8.18
2003	1.50	3.59	7.39	7.63	8.16	6.79	7.13	7.62	0.83	7.24	7.13	7.93	7.56	7.59
2004	0.63	2.89	7.12	7.03	7.66	6.19	6.64	7.15	0.31	6.52	6.51	7.64	7.16	7.00
2005	0.44	2.31	6.75	6.94	7.31	5.69	6.17	6.89	0.33	5.89	6.38	7.11	6.88	6.27
2006	0.48	2.00	6.37	6.42	6.84	5.41	5.83	6.53	0.35	5.55	6.16	6.67	6.93	5.96
2007	0.50	1.97	5.95	5.89	6.49	5.06	5.28	6.26	0.29	4.87	5.65	6.31	6.58	5.52
2008	0.87	2.09	5.59	5.84	6.28	4.74	5.01	6.21	0.58	4.67	5.53	5.98	6.38	5.32
2009	1.81	2.12	5.55	6.06	6.11	4.53	4.67	6.02	0.72	4.70	5.40	5.76	6.30	5.08
2010	1.41	2.25	5.56	5.71	5.93	4.48	4.71	5.82	0.44	4.70	5.23	5.38	5.92	4.75
2011	1.40	2.12	5.00	5.39	5.64	4.26	4.34	5.86	0.38	4.63	5.12	5.12	5.55	4.66
2012	1.70	1.54	4.76	5.08	5.53	4.03	4.16	5.50	0.61	4.46	5.00	5.09	5.48	4.35
2013	1.85	0.95	4.92	5.18	5.53	3.81	4.35	5.36	0.06	3.90	4.34	5.10	4.78	4.33
2014	2.16	1.15	4.92	4.85	5.72	3.95	4.18	5.62	0.12	4.21	4.25	4.99	4.83	4.24
2015	1.82	1.13	4.94	4.56	5.72	3.89	4.11	5.25	0.00	4.16	4.21	4.82	4.81	3.89

Table C1. Estimation Results of Corruption Index of China's 30 provinces over 1995–2015 (Continued)

YEAR	Shan Dong	He Nan	Hu Bei	Hu Nan	Guang Dong	Guang Xi	Hai Nan	Chong Qing	Si Chuan	Gui Zhou	Yun Nan	Shan Xi(2)	Gansu	Qing Hai	Ning Xia	Xin Jiang
1995	9.48	9.63	9.25	9.41	8.55	9.54	8.44	9.37	9.15	9.77	9.22	9.56	10.00	9.79	9.70	9.42
1996	9.22	9.19	9.17	9.15	8.38	9.41	8.45	9.23	9.09	9.67	9.01	9.48	9.75	9.72	9.77	9.52
1997	9.03	9.04	8.98	9.13	8.50	9.10	8.81	9.32	9.31	9.38	8.93	9.10	9.49	9.28	9.34	9.43
1998	9.10	9.17	8.99	9.04	8.34	9.10	8.84	7.82	9.23	9.18	9.04	9.08	9.34	9.25	9.09	9.51
1999	9.03	9.24	8.95	9.05	8.20	9.14	8.55	7.66	9.05	9.06	9.04	8.84	9.29	9.00	9.09	9.39
2000	8.75	9.07	8.60	8.84	8.17	8.93	8.66	7.38	8.75	8.89	9.08	8.48	9.06	8.81	8.87	8.95
2001	8.40	8.87	8.20	8.56	7.80	8.84	8.38	7.23	8.51	8.80	9.04	8.08	8.81	8.41	8.77	8.37
2002	7.90	8.56	7.81	8.24	7.50	8.50	8.24	7.29	8.19	8.75	8.82	7.69	8.65	8.34	8.58	7.99
2003	7.45	8.29	7.31	7.76	7.33	8.36	7.53	7.09	7.82	8.34	8.27	7.12	8.25	8.44	8.14	7.92
2004	6.76	7.78	6.60	7.72	7.07	7.93	7.20	6.92	7.46	8.20	8.03	6.83	8.22	8.15	7.34	7.65
2005	5.86	7.14	6.05	6.92	6.71	7.64	7.10	6.75	7.01	7.86	7.79	6.35	8.03	7.79	7.31	7.34
2006	5.46	6.75	5.92	6.64	6.71	7.17	7.06	6.29	7.04	7.51	7.78	5.91	7.72	7.75	6.85	7.19
2007	5.06	6.06	5.46	6.23	6.38	6.72	6.02	5.92	6.63	6.94	7.34	5.49	7.15	7.10	6.07	6.63
2008	5.09	5.75	5.47	6.01	6.31	6.47	5.62	6.01	6.44	6.89	7.04	5.13	6.79	6.95	5.88	6.61
2009	5.02	5.37	5.12	6.07	6.44	6.39	5.06	5.98	6.39	6.55	6.72	4.98	6.58	6.65	5.09	6.48
2010	4.87	5.04	4.86	5.82	6.36	6.08	4.64	5.93	6.23	6.23	6.69	4.81	6.37	5.98	4.91	5.90
2011	4.70	4.85	4.50	5.46	5.87	5.78	4.36	5.67	5.96	6.00	6.27	4.54	6.20	6.37	4.97	5.64
2012	4.48	4.57	4.14	5.49	5.43	5.60	4.24	5.58	5.74	5.53	6.17	4.28	5.67	6.06	4.41	5.67
2013	4.36	4.45	4.10	5.51	4.92	5.51	3.77	5.54	5.55	5.47	6.06	4.42	5.82	5.58	4.96	5.58
2014	4.17	4.43	3.93	5.44	4.91	5.43	3.94	5.43	5.73	5.57	6.32	4.25	5.86	5.17	5.16	5.64
2015	3.98	4.24	3.96	5.52	4.61	5.29	3.98	5.36	5.71	5.50	6.37	4.22	6.06	5.70	5.29	5.69

Notes: (1) we only present the corruption index calculated by Model 3-4 due to length limitations.

(2) China has 32 provinces and two special administrative districts in total, however, we can only take 30 provinces into account for the consistency of data.

(3) Shanxi(1) is the province in central district, and Shanxi(2) is the province in west district.

Data source: our calculation.

Appendix D. The Results without Political Control (PCON)

To analyze the effect of political control on corruption, we also report the regression and estimation results of corruption without political control (PCON). The following formulas are the MIMIC regression results for China's corruption:

Measurement Model:

COR=0.1037*GOVC-0.0125*FED-3.7647*EDUH-1.3128*WAGE-1.7796*LAW
(4.44)*** (-3.55)*** (-14.88)*** (-2.87)*** (-9.12)***
+3.9753*LnPUBINV-0.1513*D.MEDIA
(11.15)*** (-2.83)***

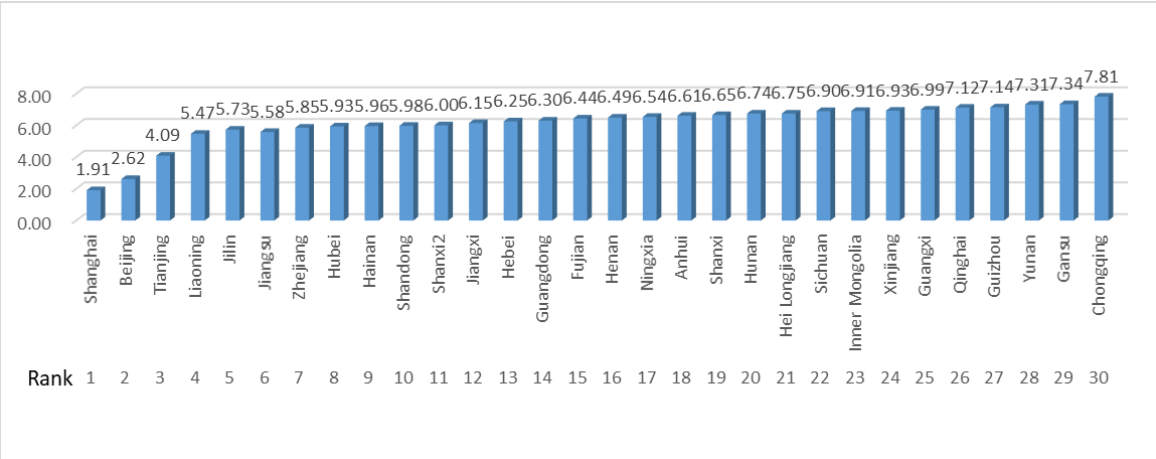
Structural Model:

CORCASE= COR+ε_1;[31] LnGDPPC =-0.1401*COR+ε_2
(-18.38)***

Fitting Statistics: chi(6) = 9.25, p=0.16; RMSEA=0.029; CFI=0.998; TFI=0.996; SRMR=0.011

As we can see, the model is still very stable without political control (PCON) as a causal variable. To make a comparison with the estimation result of Model 3-4, we present the average value of corruption index and rank of the corruption extent of 30 provinces of China in Figure D1.

Figure D1. Average value of corruption index which comes from the model without PCON



Notes: the bigger the value, the higher the rank, the more the corruption.
Data source: our calculation.

As shown in Figure D1, when political control (PCON) isn't included in the model, the

[31] Set CORCASE as the benchmark variable, so the coefficient of COR equals 1.

average values for Shanghai, Beijing, Tianjin and Chongqing all bigger than the values in Figure 3.1. In addition, the differences between the average values for Shanghai, Beijing and Tianjin and other provinces are smaller. Considering the ranks of all provinces, we find that Shanghai, Beijing and Tianjin are still the three least-corrupt districts of China, however, Chongqing becomes the most corrupt district of China. This demonstrates that political control plays a very important role in preventing corruption in Chongqing. Although there are some differences in the values and ranks of some provinces, the estimation results of this model and Model 3-4 are still highly correlated with a correlation coefficient of 0.9759. This also demonstrates that our estimation results from Model 3-4 are highly stable.