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Institutional Development and the Government Response to COVID-19 in China

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Abstract:

As COVID-19 is pervasive across the globe, governments in different countries face the dilemma of restricting the transmission risk of the virus by social distancing while yet maintaining economic activity. Inadequate social distancing policies lead to more infection cases and deaths, while over stringent social distancing policies have significant economic cost implications. This study investigates the role of local government institutions in striking the balance between saving lives and economic recovery. We based our study on a sample of 28 provincial governments in China during the early outbreak of 2020 when the emergency responses of local governments were synchronous. The findings show that local governments in those provinces with lower degrees of marketization, which were accustomed to directly intervene in the social system, mandatorily quarantined many more close contacts for each confirmed case than those in the more market-oriented provinces whose social distancing policies took economic considerations into account. The 'overdone' (over stringent) social distancing policies in the more state-oriented provinces led to lower human mobility and economic growth. This study highlights the importance of taking economic considerations into account when adopting policies and strategies to combat the spread of COVID-19 and how different institution management cultures lead to different outcomes.

Keywords: institutional development; marketization; quarantine; close contacts; population migration; overdone social distancing

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1. Introduction

The pandemic COVID-19 surged globally in more than 200 countries as of April, 2022, and caused more than 490 million infected cases and 6 million deaths.[1] Social distancing (i.e., quarantine, lockdown or stay-home orders) was proven to be one of a few instruments that can restrict the spread of the virus (e.g., Béland et al., 2020; Van Bavel et al., 2020). Culture and politics affect "tightness" and "looseness" when adopting social distancing policies. Residents from different countries may weigh freedom and health risk differently, and those countries with priority given to freedom had looser rules in response to COVID-19 (Van Bavel et al., 2020). Some studies (Haffajee and Mello, 2020; Yamey and Gonsalves, 2020) show that the US federal government acted slowly and inadequately to contain the spread of the virus.[2] Political partisanship in the US also mitigated people's compliance with social distancing policies and affected state-level government responses to the virus.[3] Contrary to the US, China adopted very aggressive social distancing policies at the beginning stage of the pandemic, including the complete shutdown of Wuhan and other cities in Hubei Province, and implemented the policies of "closed management of communities" and "family outdoor restrictions" in more than 250 prefecture cities outside Hubei (Fang et al., 2020, Qiu et al., 2020).[4] The studies in the US show that political polarization of state governments caused inadequate social distancing policies (e.g., Adolph et al., 2021; Tellis et al., 2020). Against this background, this research investigates the overdone social distancing policies by some local governments in China during the early outbreak in 2020 due to variations in institutional developments between different provinces.

In the past four decades China has gradually shifted from a centrally planned to a market-oriented economy, a core institutional development coined as marketization. Key changes in this process include establishing factor and product markets, adopting market mechanisms in allocating

[1] See the statistics from World Health Organization: https://covid19.who.int.
[2] As of April 2022, US had the most confirmed cases of COVID-19 (80,158,183) in the world, including 982,571 deaths.
[3] Residents in republican counties or counties with more Trump voters were less likely to strictly obey the social distancing orders than Democrats (Barrios and Hochberg, 2020; Painter and Qiu, 2020). Republican governors were also slower than Democratic governors to mandate social distancing (Adolph et al., 2021; Grossman et al., 2020).
[4] Wuhan was epicenter of COVID-19 and completely locked on January 23, 2020. Other cities in Hubei Provinces were also shut down on the same date or the next date. Public transportation was shut down in these cities. Local governments in most cities implemented policies to restrict entry and exit of the communities (closed management of communities) and allow only one family member to go out once every one or two days (family outdoor restriction). See the discussions in Qiu, Chen and Shi (2020).

resources, nurturing market intermediaries and providing a legal environment (Fan and Wang, 2001). Local governments are restrained from the role as planner, directly controlling and intervening in the economic and social systems. As marketization deepens, coupled with the fiscal and political decentralization, local governments have become more autonomous, and government officials are incentivized to pursue economic growth (Walder, 1995; Wu, 2002). However, the marketization process varies across provinces in China, which allows us to exploit the variations in government responses to COVID-19 between different provinces.

This study hypothesizes that provinces with lower marketization, i.e., state-oriented provinces, were accustomed to intervening in the social system and would implement over stringent social distancing policies to handle the COVID-19 pandemic. Local governments in the state-oriented provinces are "constrained social planners" (Fenichel, 2013) that tend to constrain all individuals regardless of their health status and the low risk of transmission. As aggressive social distancing policies are associated with substantial increases in the unemployment rate and GDP loss,[5] local governments in provinces with high marketization or market-oriented provinces would weigh between the economic cost of social distancing and the health cost of public health risk. Local governments in those provinces may not implement "overdone" policies. They did quarantine targeted individuals on a health classification basis (Fenichel, 2013). It is expected that economic activities could be encouraged and restarted once the pandemic is under control.

We test the hypotheses by examining the strictness of social distancing policies implemented by local governments and their impacts on economic activities. A policy in China to prevent the transmission of COVID-19 is to trace and quarantine the close contacts of confirmed cases and suspected cases. Local government officials, under the diagnosis guidelines issued by the Chinese Centre for Disease Control and Prevention (the state CDC), identified the close contacts. As the definition of close contacts is not very clear (which is explained in the background section, below), it leaves great scope for the exercise of discretion by local government officials. We used the number of close contacts per confirmed case in a province to measure whether social distancing policies could be overdone. Given that the reproduction numbers of COVID-19 between

[5] China recorded a 6.8% contraction in its economy in the first quarter of 2020, which was the first negative quarterly GDP growth since 1982. Hubei Province, the epicenter of the coronavirus and with complete city lockdown policy from January 23, 2020, had a negative 39.2% GDP growth in the quarter. See https://www.scmp.com/economy/china-economy/article/3080882/coronavirus-china-seen-pursuing-lower-2020-economic-growth. GDP in the US fell 4.8% in the first three months of 2020 and is expected to contract more than 30% in the second quarter. See https://www.nytimes.com/2020/04/29/business/economy/us-gdp.html.

January to February of 2020 were similar in the provinces outside Hubei (Liu et al., 2020), a higher number of close contacts per confirmed case indicates that the local government concerned mandated the quarantining of some individuals with low exposure risk. The effect of social distancing policies on economic activity is captured by a population migration index (Fang et al., 2020) and economic growth in the first quarter of 2020. If the state-oriented provinces overdo their quarantine policies, human mobility in these provinces would be restricted at a higher rate; thus, the population intensity should be reduced at a higher rate in the state-oriented provinces than in the market-oriented provinces. Cities in these provinces could also suffer larger decrease of economic growth. Following previous studies (e.g., Li et al., 2009; Hasan et al., 2014), the level of marketization in Chinese provinces is measured by a marketization index (Fan et al., 2019),

Based on a daily sample of close contacts and population migration index in 28 Chinese provinces between January 24, 2020 and February 26, 2020, this study shows that a higher number of close contacts per confirmed case had been mandatorily quarantined in the state-oriented provinces (40.39 close contacts per confirmed case) than in the market-oriented provinces (26.31 per confirmed case). This indicates that state-oriented provinces adopted a much more stringent social distancing strategy than the market-oriented provinces. The quarantine measures in those state-oriented provinces could be overdone, given that the number of confirmed cases and their transmission risk of COVID-19 alike were much lower. Over the same period, human mobility in the market-oriented provinces, by contrast, was much higher than that in the state-oriented province, by 16.8% (or 18.1% in comparison with mobility in 2019). This indicates that local governments in those provinces did not implement overdone policies and were more inclined to maintain economic activities.

Further tests based on 285 prefecture (and above) cities in China in the first quarter of 2020 show that although all cities implemented a Level 1 Emergency Response Situation to contain the virus, population flows were reduced more in the state-oriented cities than in the market-oriented cities during the period of emergency response. These results again indicate that social distancing policies of state-oriented governments were more stringent than those of market-oriented governments. Economic growth rate in 2020Q1 also decreased more due to the emergency response in the state-oriented cities than in the market-oriented cities. For the following controls of pandemic by China government before Omicron spreads, a study of 32 local outbreaks from May 2020 to January 2022 indicated that state-oriented cities were more likely to implement strict

control (instead of selective control, which could be more precise in restricting the spread of infection and minimize economic cost), but took longer to contain the epidemic spread and had more confirmed cases than market-oriented cities. Overall, the findings in this study suggest that institutional development has an important effect on the efficiency of crisis responses.

The objective of this research is to study how institutional developments in Chinese provinces significantly affected local government response to the COVID-19 outbreak. The study contributes to two streams of literature. First, to institutional development studies and their roles in economic and social systems (e.g., Hui and Yu, 2009; Li et al., 2009; Fan et al., 2012; Hasan et al., 2014; Zhou, 2014; Zhou and Hall, 2017; Li et al., 2020). The study is the first empirical study documenting that institutional developments sharpened the behaviour of local governments in China and affected government responses to a public health crisis. This research also adds to the emerging studies of COVID-19, its impacts on the economy and society, strategies to control the outbreak and the impacts of urban governance on COVID-19 control and prevention (e.g., Fang et al., 2020; Greenstone and Nigam, 2020; Mishra et al., 2020; Pan et al., 2020; Qiu et al., 2020; Chen et al., 2021; Chu et al., 2021; Yang and Chong, 2021). Different from studies in the US, which show politics lead to inadequate social distancing and thus harms public health (e.g., Adolph et al., 2021), this research shows that some local governments could overdo social distancing if the associated economic loss was not considered. This has important policy implications for governments which adopted stringent social distancing policies.

2. Background, literature review and hypotheses development

2.1 Background

Local governments in the pandemic

The massive outbreak of COVID-19 in China started in the last week of January 2020. Immediately following this, the government kicked off its systematic response to fight back. On January 23, 2020, a momentous shutdown, with traffic bans for all residents, was implemented in Wuhan city, with the intent of restricting the spread of the virus. Figure 1 shows that the pandemic had reached a climax and had fallen back within the next five weeks nationwide from January 23 to February 26, 2020. 14,109 new daily cases had been reported by the state CDC on February 12 when Hubei province began to include clinically diagnosed cases. The record high had been 3,694

cases/day on February 5.[6] After February 26, the curve had flattened significantly. Notably, the transmission of coronavirus in provinces outside Hubei had been contained effectively, but with different social costs and implications among the different provinces.

[Insert Figure 1 here]

The provincial governments in China are the first layer of local governments which deliver and allocate the strategies, plans and public resources of central government to municipalities in territorial jurisdiction (Gao and Yu, 2020; Xu and Yang, 2020). During the epidemic, each provincial government response to COVID-19 could be divided into two categories of policies reflecting the intervention of central governance or "central-initiated", and policies initiated by provincial governments themselves or "local-initiated". The implementation of these two types of policy would differ between provinces because of the variations in institutional development.

Once the central government announced a major strategy to fight the pandemic, the provincial governments would act instantly to execute and promote their own actions accordingly. For example, the Central Leadership Group for Epidemic Response was launched on January 25, 2020, while the branch Local Leadership Groups of 30 provinces had been established within 48 hours.[7] Based on that, local governments instantaneously executed the systematic intervention measures of central government. Those measures include local social distancing strategies and quarantine plans, according to the state CDC guidelines and protocols[8], special financial support

[6] All data came from open source of the state CDC, see http://www.chinacdc.cn/jkzt/crb/zl/szkb_11803/jszl_11809/index.html

[7] As the center of the pandemic, Hubei government had established the special leadership on January 22, 2020. Tibet was the province where Local Leadership Group had been established last on January 27, 2020.

[8] Two major guidelines and protocols had been released by the state CDC in China and amended very soon in early weeks of the development of COVID-19, namely Protocol for Prevention and Control of COVID-19, Diagnosis and Treatment Protocol. Others include Investigation and Management of close contacts of COVID-19 cases, Management of asymptomatic persons, Epidemiological investigation and lab testing (e.g., see, http://www.chinacdc.cn/en/COVID19/).

for local governments and enterprises[9], political incentives policies[10], and launching an emergency collaboration between various functional departments (transportation[11], labor[12], education[13], etc.), with the intent to reduce inter-region population flow and maintain social distancing. The institutional development or, say, the "manner", or political culture of local governments, would influence the implementation of central-initiated policies at provincial scope differently. Differences, such as the content of public awareness were observed among provinces adopting the central-initiated response, as well as the level of local transportation control, the extent of closed management of communities, and how to execute an effective quarantine. For example, a daily update online (or offline) about the pandemic by local governments, the disclosure of information on coronavirus spread to the public, was compulsory under the Emergency Response Situation (ERS). Some provinces provided more frequent news releases, such as every 12 hours, in Beijing, Shanghai, Liaoning, Shandong, and Chongqing. In Hunan Province, briefings in multiple languages including English, French, and Japanese were released to all residents. Demographic

[9] Ministry of Finance completed subsidy allocation for pandemic control for 11.2 billion RMB on January 26, 2020 (see http://www.gov.cn/guowuyuan/2020-01/26/content_5472344.htm). On the next day, another aid plan for local pandemic control of 60.3 billion RMB had been issued (see https://www.guancha.cn/politics/2020_01_27_533326.shtml), as well as 0.44 billion RMB for emergency subsidies to local governments (see https://tech.sina.com.cn/roll/2020-01-28/doc-iihnzhha5125222.shtml). Other financial support for relevant personals had been practiced, such as medical cost for treatment of confirmed and suspect cases would been waived (see http://www.nhsa.gov.cn/art/2020/1/27/art_37_2290.html), and doctors and medical workers in anti-epidemic work would be specially subsidized by 300 or 200 RMB per day per person (see http://finance.china.com.cn/news/20200130/5182398.shtml). After the climax of disease development in February, an economic recovery plan had been released by National Market Monitor Bureau, National Medical Inspection Bureau and National Intelligence Property Right Bureau on Feb. 15, 2020 (see http://www.gov.cn/zhengce/zhengceku/2020-02/15/content_5479457.htm).

[10] The fight to confront the pandemic instantly became a such leading priority of national strategies that on January 28 and 29, 2020, the Central Organization of CPC released two important policies that the personal performance in control and prevention of COVID-19 of local government would be considered tremendously in officials appointment (see: http://www.xinhuanet.com/politics/2020-01/28/c_1125508545.htm , and http://www.xinhuanet.com/politics/2020-01/29/c_1125510815.htm). The political incentive policy had been implemented quickly at provincial administration that a few local officers who misconducted on duty of Hubei Province had been removed from their posts on January 30, 2020 (see: https://hb.ifeng.com/a/20200130/8162957_0.shtml). Dozens in different provinces had been affected in February.

[11] Ministry of Transportation launched Level 2 responses to emergencies on January 21, 2020, to monitor the body temperature of passengers at highway checkpoints and controlling the inflow of population (see: https://news.sina.com.cn/c/2020-01-21/doc-iihnzahk5659389.shtml); on the same day, the change fees were waived for flight, train, bus and ferry tickets by the Ministry of Transport of China, Civil Aviation Administration of China, and the China State Railway Group Company (see: https://www.thepaper.cn/newsDetail_forward_5591272).

[12] China State Council extended the Spring Festival Holiday for 3 more days nationwide on January 26, 2020 (see: http://www.gov.cn/zhengce/content/2020-01/27/content_5472352.htm).

[13] Ministry of Education postponed the start of the 2020 spring semester for all universities and K-12 institutes on January 27, 2020 (see: http://www.gov.cn/zhengce/zhengceku/2020-01/28/content_5472571.htm).

characteristics and detailed travel records of confirmed cases had been disclosed daily in Hainan Province. This was very rare in early February in all provinces.

More nonconformity and asynchrony could be found among local-initiated measures and policies. For example, the timing to launch a Level I Emergency Response Situation (Level I ERS)[14] and when to downgrade to Level II or lower were diverse among provinces. Figure 2 shows that Level I ERS had been first announced in Guangdong, Zhejiang, and Hunan province on January 23, 2020, even one day earlier than Hubei province.[15] When the pandemic relief occurred, in most parts of the country in late February, a downgrade of Level II ERS was issued first in Guangdong and in two other provinces on February 24, 2020. The alert was lowered gradually in March, although a top ERS remained in the Beijing-Tianjin-Hebei integration area until April 30, 2020.

[Insert Figure 2 here]

Creative interventions had been pioneered in practice by some local governments such as the use of mobile internet technology for contact tracing, social distancing, and quarantine (Ferretti et al, 2020). On February 11, 2020, Hangzhou municipal was the first to promote a Health QR code[16] to city residents, which has been proved effective and efficient. The code has been applied to all citizens in Zhejiang, Sichuan and Hainan provinces one week later. 15 million persons had registered the Health code in Zhejiang by then[17] and all around the country by the end of February.

"Overdone" quarantine in some provinces

Early detection of the COVID-19 outbreak and prevention of its onward transmission are crucial (Gilbert et al., 2020). Building a system to promote effective prevention and control of virus spread includes identifying confirmed cases, tracing the possible cases in a short time and promoting social distance policy among general city residents. Quarantine could in overdone in

[14] Regulation on the Relief of National Natural Disasters was launched in 2006 and amended in 2016 in China, which gave protocols when major natural disaster or public health emergency on local leadership and relief organization, disaster warning, public information sharing, emergency response levels, and post-disaster reconstruction and recovery. There are 4 Levels of emergency response situation, depending on the size of casualty and the range of influenced area (see http://www.gov.cn/zhengce/content/2016-03/24/content_5057163.htm).

[15] Sixteen provinces launched Level I ERS including Beijing, Shanghai and Hubei on January 24, 2020. On the next day 12 other provinces followed the wave which are mostly located at the west and north part of the country. Tibet was the last one on January 27, 2020.

[16] A mobile phone application helps to contact tracing instantaneously.

[17] Report by China Daily, Feb. 24, 2020
(see: https://language.chinadaily.com.cn/a/202002/24/WS5e53345aa310128217279c11.html).

two ways: firstly, much more people would be targeted as "suspected" cases and put into mandatory quarantine; and secondly, a larger area of city regions would be locked down than necessary.

Two major protocols had been released by the state CDC government officers to guide local practices, for *Diagnosis and Treatment Protocol of Novel Coronavirus Pneumonia* which enables the clinical identification of cases, and *Protocol for Prevention and Control of COVID-19* for non-clinical management of possible cases. According to the national protocols in February, when an instant nucleic acid testing was absent, a person who showed certain clinical symptoms and had questionable travel history[18] would be categorized as a "*suspect case*", registered in the CDC system in 48 hours and hospitalized while waiting for the test results. Once a positive test result was identified for the suspect case, the person's status would be changed to *confirmed case* in the system. In hospitals, suspect and confirmed cases would be quarantined equally and receive clinical treatment. As for possible cases, persons who lived together, took care of, or travelled with suspect cases or confirmed cases would be identified as *close contacts*[19] and would be quarantined at home or at government-authorized facilities for 14 days[20]. However, under the unified principles of these Protocols, there was evidence that some provinces could "overdo" the measurements and place unnecessarily more personnel in quarantine. Overdone social distancing policies could be implemented to restrict social activities by different means, such as outdoor activity restrictions and no entrance for people related to an "infected" area[21] for a long time. The level of "overdone" measurements can be reflected in the manner in which government officials traced and mandatorily quarantined the close contacts.

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[18] In the 3rd Edition of "Diagnosis and Treatment Protocol" released on January 22, which was widely used at local hospitals, a suspect case was identified as "any person who has any one of the epidemiological history plus any two clinical manifestations or all three clinical manifestations if there is no clear epidemiological history". The epidemiological history included travel history to Wuhan in 14 days, contact history with people who had travel history to Wuhan and got a fever, and clustered cases. See http://www.nhc.gov.cn/yzygj/s7653p/202001/f492c9153ea9437bb587ce2ffcbee1fa/files/39e7578d85964dbe81117736dd789d8f.pdf

[19] Possible cases namely "*close contacts and suspect exposure subjects"* has been raised up for the first time in the second Edition of *Protocol for Prevention and Control of COVID-19* published on January 22, 2020. And, after that, the detailed plan for identification and management of close contacts would been released as the attachment for each edition of the Protocol.

[20] Referred to the 3rd Edition of *Protocol for Prevention and Control of COVID-19* which published on January 28, 2020. See http://www.nhc.gov.cn/jkj/s7923/202001/470b128513fe46f086d79667db9f76a5.shtml.

[21] In February 2020, the "infected" area had been focused in Hubei province and Zhejiang province (Wenzhou).

The overwhelming, and sometimes confusing, information about the pandemic and the lack of local protocols made the work somewhat ineffective in a couple of ways. First, the official CDC guidelines for *cases* identification and *close contacts* management were amended and updated in a timely manner[22], but local protocols were not. There is uncertainty that requires local officials' discretion. Secondly, unofficial information made the exclusion criteria for suspect cases ambiguous. Such as the research finding that the asymptomatic period might be longer than the typical 14 days[23] and news about multiple "fake" negative test results for confirmed cases. Under the harsh political environment of loss of job if you miss any time, in provinces such as Shannxi and Ningxia, local officials tended to extend the target population, putting more possible cases into mandatory quarantine as long as they could and lessen their own career risk. Hence more suspect cases were registered there, and more of their close contacts too.

For example, in Shannxi Province in February 2020, the close contacts of a *suspect case* would be quarantined in government facilities only, not "home or government facilities" as state Protocol instructed, within 48 hours after the suspect case was registered. The close contacts of "close contact" would also be traced and quarantined at home for 14 days. Even when the suspect case had tested negative for the coronavirus and been discharged[24], his/her close contacts would have to stay quarantined for the whole 14 days. The result was a large number of close contacts distanced from their normal life in some provinces, as seen in Figure 3.

[Insert Figure 3 here]

2.2 Literature review and hypotheses development

After its open-door policy in 1978, China has gradually transformed itself from a state-oriented planned to a market-oriented economy. Market-oriented reforms, including the

[22] The first edition of two protocols was released on Jan 15, 2020. After 50 days until early March, seven editions of Diagnosis and Treatment Protocol and six editions of Protocol for Prevention and Control of Covid-19 had been released (see http://www.chinacdc.cn/en/COVID19/202003/P020200323390496137554.pdf). The smallest interval of two editions was only three days. The latest 9th Diagnosis and Treatment Protocol had been released on March 2022 and the latest 8th Prevention and Control Protocol had been released on May 2021.

[23] On Feb 9, 2020, Prof. Zhong Nanshan, the prestige specialist with great contribution in SARS 2003, had published his latest research on coronavirus on medRxiv, in which other than typical 14 days, the longest asymptomatic period of confirmed case for 24 days has been observed (see https://news.sina.com.cn/c/2020-02-10/doc-iimxxstf0281915.shtml). The news raised a new wave of panic, and local officials started to quarantine more people who related to Hubei with no specific time criteria.

[24] Even though the suspect case had been discharged from hospital, he/she would have to be relocated to another government facility to stay quarantine for another 14 days because of the contact history of the "infected" area, hospital.

development of product and factor markets and the nurturing of non-state enterprises, market intermediaries and a legal environment. This results in institutional developments in China, which can be reflected in its curtailing of government dominance in the economy and in the use of market-based rules in resource allocation (Fan et al., 2012). The marketization process has also shaped the behaviour of local government (Wang et al., 2015) and weakened the direct influence of central government on local governance (Wu, 2002; Yeh et al., 2015). Fiscal decentralization was launched in the early 1990s. Local governments could retain some revenues and maintain a healthy balance of their own budgets within a certain degree of local autonomy. The central government incentivized local governments to pursue economic growth and harness local economic activities (Walder, 1995; Wu, 2018). Economic reforms also led to entrepreneurial endeavours among local governments in market-oriented provinces (Walder, 1995; Wu, 2002).

Market-oriented reforms have significantly affected the institutional development and the efficiency of resource allocation in China, such as housing, land, labour and financial resources (Wang et al., 2015; Shen et al., 2016; Li et al., 2020; Li, Hui and Shen, 2020). The marketization process, however, is not uniform across provinces in China. In general, marketization is higher in the eastern regions such as Guangdong and Zhejiang where economic reform began earlier, than in the western regions such as Ningxia and Gansu. Many studies have investigated the regional disparities of institutional development in China due to the heterogeneity of marketization. It is found that institutional development spurs economic growth in Chinese provinces (Fan et al., 2012), increases a firm's access to financial resources (Li et al., 2009), induces a firm to disclose more reliable firm specific information (Hasan et al., 2014), and enhances entrepreneurship and entrepreneurial performance in China (Zhou, 2014; Zhou and Hall, 2017).

However, the impact of institutional development on the behaviour of local governments has not been well investigated in the literature. COVID-19 provides a good chance to observe the responses of governments to a public health crisis and the effect of institutional development on their responses. As local governments in China played a central role in allocating public resources to combat COVID-19, implementing proper measures to both contain the spread of virus and avert economic recession, the institutional development (and marketization) in a province could substantially affect the outcomes of government policies and the interactions between local governments and citizens.

Previous studies have found that city characteristics and urban governance affect crisis responses and COVID-19 prevention and control (Chen et al., 2021; Chu et al., 2021; Khavarian-Garmsir et al., 2021). There are several reasons why institutional development in a province might affect its government response to COVID-19. First, in provinces with less marketization, government involvement in economic activities and other aspects in society are still pervasive. Local governments in the provinces can directly exert influence on the local economy through state-owned enterprises and maintain strong control over urban communities (Wu, 2002). In contrast, base-level democracy and self-organized bodies arose in those highly marketised provinces hence nurturing urban civilization and new form of governance in Chinese cities (Wu, 2002). Depending on the level of marketization and the withdrawal of government involvement in a social system, local governments could adopt a variety of response strategies to contain the spread of coronavirus. Local governments in the state-oriented provinces are accustomed to respond to commands from central government and directly intervene in economic and social activities. These provinces may adopt more stringent measures such as a tighter level and a longer time of lockdown of communities than the market-oriented provinces.

Second, shifting from a state-planned economy to a market-oriented economy creates a stronger incentive for government officials to pursue economic growth (Walder, 1995). Implementing rigorous social distancing measures may effectively reduce the risk of virus transmission but is also associated with loss of economic benefits (Fenichel et al., 2011). Fenichel (2013) compared three different levels of intervention. That is, the social welfare in the case of policies of no intervention, intervention only on targeted or infected individuals with economic considerations in mind, and non-targeted intervention on all individuals by a constrained social planner. He showed that the outcomes for social welfare from constraining all individuals regardless of health classification could be even worse than the outcomes from no intervention policy. Government officials in the market-oriented provinces have incentives to minimize the negative economic impacts of social distancing and preserve economic growth. So, they are more likely to adopt proper targeted intervention policies based on the health classification of targeted individuals. On the other hand, local governments in state-oriented provinces are likely to be constrained social planners that adopt “overdone” quarantine policies and constrain many more individuals regardless of health status. The government, therefore, could affect local government

decisions on whether only targeted individuals based on health classification, or more individuals regardless of risk exposure to COVID-19, would be mandatorily quarantined.

Lastly, marketization also sharpens the entrepreneurial endeavour of government officials in the market-oriented provinces (Wu, 2002; 2018). These provinces, therefore, could employ new methods to track and contain the potential virus transmission, such as the Health QR code as initiated in Hangzhou and Zhejiang Provinces. These new measures could be more efficient than, and an important supplement to, traditional quarantine measures. However, government officials in the state-oriented provinces may not risk their political careers by taking bold and innovative actions but, rather, stick to the instructions and policies set by central governments.

In short, we argue that institutional developments resulting from marketization affects local government responses to COVID-19 in China. Hence, these two behavioural aspects related to the consequences of local government response are examined. First, we looked at the close contacts mandatorily quarantined in a province. Although the state CDC gives formal instructions on the identification of close contacts, local authorities can use their discretion in determining who can be classified as close contacts. As discussed above, local governments in the state-oriented provinces remain strong in intervention in the community and can act to constrain more individuals than local governments in the market-oriented provinces who would consider both the health cost of the virus and economic cost of public interventions. Overdone social distancing measures could be reflected in the number of close contacts per confirmed case.[25] An example of rigorous policy in identifying close contacts in Shannxi Province is discussed above. The first hypothesis is given as:

H1: During the COVID-19 pandemic period, state-oriented provinces have a significantly higher number of close contacts per confirmed case than market-oriented provinces.

Social distancing policies significantly reduce human mobility (Fang, et al. 2020; Kraemer, et al., 2020) and bring down economic growth (Barrot, et al., 2020). Restarting the economy can be as important as containing virus transmission (Favero, et al., 2020; McKee and Stuckler, 2020).

[25] Given a similar basic reproduction number of COVID-19 in the provinces outside Hubei (Liu et al., 2020), the number of potentially infected cases and close contacts for each confirmed case should be similar across provinces. A higher number of close contacts per confirmed case could be attributed to the overdone quarantine policy rather than a necessary and proper action to contain virus transmission. Note that by mid-February 2020, the spreading of the virus was effectively restricted in all the provinces outside Hubei (Qiu, Chen and Shi, 2020).

Local governments in market-oriented provinces could be keen to maintain economic momentum and several provinces adopted policies of support to firms in restarting production and bringing migrant workers back to work. For instance, the government of Guangdong Province, a manufacturing hub in China, announced 20 policies to facilitate work resumption as early as February 6, 2020.[26] The government also scheduled chartered trains to bring back workers outside the province.[27] Human mobility in the provinces such as Guangdong and Zhejiang sharply rose after the COVID-19 was brought under control. On the other hand, local governments in state-oriented provinces might not place emphasis on economic recovery and thus maintained tighter control policies on population migration so as to minimise virus transmission risk. The overdone social distancing and quarantine policies continued, even though the spread of coronavirus had been largely contained. The second hypothesis is:

H2: During the COVID-19 pandemic period, state-oriented provinces have significantly lower population migration intensities than market-oriented provinces.

3. Data, sample, and variables

3.1 Data and sample

The hypotheses were tested using a sample of Chinese provinces in the COVID-19 pandemic period for the first quarter of 2020. The sample period starts on January 24, when most provinces outside Hubei had found confirmed cases and reported the numbers of close contacts. It ends on February 26, 2020 when the daily new cases were zero in most provinces. The sample excludes data from the three provinces, Hubei, Qinghai and Tibet. Hubei was the epicentre of the COVID-19 outbreak and most of its cities were completely shut down after January 23, 2020. The numbers of confirmed cases in Qinghai and Tibet as of February 26, 2020 were only 18 and 1, respectively. The final sample contains 24 provinces and 4 municipalities in China. This study extracted the daily COVID-19 information published by the Chinese Centre for Disease Control and Prevention, including the number of confirmed cases, suspect cases, deaths, and recovery cases. We collected the daily number of close contacts to probable and confirmed patients and the number

[26]See: http://www.gd.gov.cn/gdywdt/gdyw/content/post_2886230.html
[27] See: https://www.reuters.com/article/us-china-health-bigdata/chinas-main-manufacturing-hubs-reboot-after-virus-shutdown-idUSKCN20J15Y

of discharged close contacts reported by the provincial CDC in each province[28]. In additional tests, we also constructed a sample of 216 prefecture and above, cities in China and collected daily confirmed cases of these cities in the first quarter of 2020. Additionally, we studied government responses to local outbreaks in 32 cities from 2020Q2 to 2022Q1.[29] We manually collect information from CDC and government websites on how long it took the cases turned zero and how many the positive cases in totally. Figure 4 reports the information of local outbreaks.

[Insert Figure 4]

The population migration data were retrieved from Baidu Qianxi, offered by the internet-related service company Baidu. The company is a leading search engine provider in China. Baidu Qianxi is a visible travel map with population migration information based on Baidu's location-based service and billions of positioning requests every day from mobile users. The 2020 version of Baidu Qianxi offered population flow information including the percentage of daily outflow population from a city/province to destination cities/provinces and the percentage of daily inflow population to a city/province from origination cities/provinces. It also provided three indices as measures of inflow-migration, outflow-migration, and within-city migration population intensities in a city.[30] We collected the daily within-city migration indices and the daily inflow-migration indices for 286 cities in the provinces from January 1, 2020 and March 31, 2020, and the corresponding daily indices in 2019, covering the same period after the Spring Festivals by the lunar calendar.[31] We also obtained the percentages of outflow population from Wuhan travelling to each province between January 10, 2020 and January 24, 2020, the period of Spring movement.

We used the NERI (National Economic Research Institute) Marketization Index to measure the institutional development of a province and determine whether a province is state-oriented or

[28] Some provinces did not report the numbers of close contacts or the discharged close contacts, including Inner Mongolia, Guangdong, Guangxi, Shanghai, Sichuan, Xinjiang and Yunan.

[29] In the first part we based our study on a sample of 28 provincial governments in China during the early outbreak of 2020 when the nationwide dynamic zero-case policy was still in developing and the emergency responses were more localized. After this period, the pandemic control became "ongoing" job for local government and the dynamic zero-case policy had been developed well. Before the vicious Omicron spreads out, around 35 local outbreaks happened around the country from May 2020 to January 2022.

[30] The migration index captures the population flow across time and cities (Hui et al., 2020). The data were widely used in recent studies to explore the impacts of the control measures in China on COVID-19 spread and population movement (e.g., Chen et al., 2020; Fang et al., 2020).

[31] Baidu provided the migration index only at city level. We selected the within-city migration index in a capital city to represent the human mobility in a province. Note that a capital city is normally a political and business center of a province in China. The confirmed cases of a province largely appeared in its capital city.

market-oriented.[32] A series of studies (Fan and Wang, 2001; Fan et al., 2004, 2007, 2016, 2019) quantified the marketization progress in 31 Chinese provinces and gave the marketization index for each province year by year from 1997. The index ranges from zero to ten. The higher the index score, the higher the degree of marketization in a province. The marketization index scores are the largest in the provinces of Zhejiang (9.97), Shanghai (9.93) and Guangdong (9.86) in 2016. The provinces of Xinjiang (4.10), Gansu (4.54) and Yunan (4.55) have the lowest scores in the sample.[33] Figures 4 gives the marketization index for each province.

[Insert Figure 5]

We collected the data of GDP, GDP growth, the expenditure on public healthcare and other official statistics in each province/city in 2019 from the CEIC China database. Daily weather data in the capital city of each province such as the temperature in the first quarter of 2020 were extracted from the China National Meteorological Information Centre.

3.2 Variables

This study constructed several variables to capture the response of local governments to the spread of COVID-19 and the consequences during the pandemic period. The first represents the number of close contacts per confirmed case (or how many multiples of the number of confirmed cases). The variable directly measures the strictness of the prevention and control policy adopted. The higher this figure, the more rigid a province implements the control policy. We calculated the multiple by the cumulative number of close contacts to the cumulative number of confirmed cases in a day (*MULTIPLE*) and the number of new close contacts to the number of new confirmed cases in a day (*NEWMULTIPLE*). The variables *LNMUL* and *LNMUL* are the natural logarithm of the multiples. The consequence of the government response is also measured

[32] This index is designed to quantify the marketization process across provinces in China based on five dimensions, including the relationship between government and markets, the development of non-state sector in the economy, the development of product markets, the development of factor markets, and the development of market intermediaries as well as legal environment (Fan et al., 2012). There are 23 sub-indices under the five aspects. A comprehensive list of the sub-indices can be found in Fan and Wang (2001) and Appendix A in Li, Yue and Zhao (2009).

[33] The marketization index was constructed based on official statistics and surveys. The most recent report of marketization was published in 2019 (Fan, Wang and Zhu, 2019) and gave the index to measure the marketization of each province in 2016. The index scores are consistent across provinces and years. In the robustness tests, we also used the average scores in each province between 1997 and 2016. The results remain similar.

by human mobility, represented by the within-city population migration index in a capital city.[34] We used both the raw daily migration index in 2020 (*IMG*) and the ratio of daily index in 2020 to the corresponding daily index in 2019 (*IMGADJ*). The variables *LNIMG* and *LNIMGADJ* are the natural logarithms of the daily migration index and the adjusted migration index, respectively. We also measured the economic cost of government response to COVID-19 using economic growth statistics in Chinese cities. The variable *GDPGRH* is the GDP growth rate in 2020Q1, calculated from GDP in each city in 2020Q1 and 2019Q1.

We used the marketization index to measure the institutional development in a province (see Figure 3). The 28 provinces in the sample are divided into two groups according to the marketization index in 2016: state-oriented (the index below the median value) and market-oriented (above median). A dummy variable *STATE* is created to indicate whether a province is state-oriented. We also used the index score as key independent variable in the regression analysis. The variable *LNMKT* is the natural logarithm of the marketization index score. The variables to control the heterogeneity of a province include the GDP in 2019 (*GDP19* and *LNGDP19*), the GDP growth rate in 2019 (*GDPGTH19*), the ratio of public healthcare expenditure to GDP in 2019 (*PUBHEALTH*), the number of confirmed cases (*LNCASE*), and the percentage of outflow population from Wuhan to a province (*FROMWUHAN*).[35] Weather conditions can affect both the intensity of social activities and the possibility of virus transmission (Qiu et al., 2020). We constructed three weather related variables for each capital city to control for the weather effect: a) the average temperature on a day during the sample period (*TEMPERATURE*), b) a dummy variable indicating whether it rains in a day (*RAIN*) and c) a dummy variable indicating whether it snows in a day (*SNOW*). We also created a dummy variable to capture whether a city in a province implemented a city lockdown policy (*LOCKDOWN*) to contain the spread of virus.[36] The detailed variables definitions are in Appendix 1.

[34] In the unreported results, we find that the population migration intensity in a city is positively related to GDP growth of 2020Q1 in a city. Population migration index thus can reflect the impacts of government response on economic activities.

[35] Qiu, et al (2020) find that the population outflow from Wuhan can significantly explain the numbers of confirmed cases in the cities outside Hubei Province. We expect that provinces with more population flow from Wuhan could also implement more stringent control measures to contain the spread of virus.

[36] Major cities in Hubei Province were completely shut down after January 23, 2020 or January 24, 2020. Some cities outside Hubei Province were partially shut down since February 4, 2020, including Zhengzhou (capital city of Henan Province), Hangzhou (capital city of Zhejiang Province), Harbin (capital city of Helongjiang Province) and Fuzhou (capital city of Fujian Province). These cities implemented tight control measures to restrict the human mobility, such

Summary statistics on the variables in this paper are given in Table 1. Panel A of Table 1 gives the statistics of daily variables. The average daily number of cumulative confirmed cases is 316, and the average daily number of new confirmed cases is 13. The average numbers of cumulative close contacts and new close contacts in a day are 8,564 and 424, respectively. On average, the close contacts per confirmed case is 27.139 and the new close contacts per new confirmed case is 52.181. The average daily within-city migration index in the sample period is 1.920, which is much lower than the average daily index of 4.125 in the corresponding period in 2019. Panel B of Table 1 presents the statistics of provincial level variables. As we categorized the 28 provinces based on the median value of the marketization index, 50% of the provinces belong to the state-oriented group. The average marketization index score is 7.018, ranging from 4.10 to 9.97. The GDP growth in the 28 provinces averaged 8.17% in 2019. The average percentage GDP of public healthcare spending is 6.13%.

[Insert Table 1 here]

4. Empirical analysis

4.1 Univariate analysis

Table 1 reports the numbers of confirmed cases and the close contacts as of February 26, 2020 in the provinces, grouped by the marketization index. The average number of confirmed cases (close contacts) in the market-oriented provinces is 747 (20,869), and the average number in the state-oriented provinces is 175 (7,404). On average, a market-oriented province identified 26.31 close contacts per confirmed case, and a state-oriented province quarantined 40.39 close contracts for each confirmed case. The provinces with the largest close contact-to-confirmed multiples in the market-oriented group are Chongqing (40.70), Fujian (36.76) and Zhejiang (33.64); while the provinces of Shaanxi, Ningxia and Gansu in the state-oriented group have multiples as high as 77.18, 61.76 and 46.82. The average percentage of outflow population from Wuhan to the market-oriented provinces before the shutdown of Wuhan city is 1.73%, which is much higher

as suspending public transport and setting up checkpoints. Sixteen capital cities also set up checkpoints and quarantine zones on varying dates between February 4, 2020 and February 12, 2020. The control policies were less stringent in these cities than shutdown cities. See the list of cities in Table A1 in Fang et al (2020).

than the 0.43% of the state-oriented provinces.[37] Overall, although the market-oriented provinces have many more confirmed cases and a higher population migration from Wuhan, they identified a lower number of close contacts per confirmed case than the state-oriented provinces.

[Insert Table 2 here]

Figure 6 shows that the multiples of close contact-to-confirmed cases in the state-oriented provinces are consistently larger than the multiples in the market-oriented provinces over the sample period. The multiples in the state-oriented group rose quickly in the first two weeks of the sample period even though those provinces do not have a large number of confirmed cases.

[Insert Figure 6 here]

Figure 7 shows the evolutions of the within-city population migration index in the capital cities of state-oriented and government-oriented provinces. We show the trends of the adjusted migration index (the log of index in 2020 divided by the corresponding index in 2019) in the sample period. It shows that the within-city migrations in 2020 drop significantly in both groups, compared with those in the corresponding period of 2019. The adjusted migration indices are similar in the first week after January 24, 2020 in the two groups. The state-oriented provinces have higher migrations than the market-oriented provinces between January 30, 2020 and February 10, 2020, probably because of the higher number of both confirmed cases and close contacts in the market-oriented provinces.[38] After February 10, 2020, the migration indices in the state-oriented provinces become smaller than those in the market-oriented provinces. February 10 was the first day that many provinces resumed work after the extended Spring Festival holiday and the arrangement of work from home.[39] The removal of human mobility restrictions, due to the need

[37] The province with the largest population out-migration from Wuhan is Hubei Province, that is, a very large population outflow from Wuhan to other cities in Hubei province. The percentage is 69.40%. Other than Hubei, the top three destination provinces for the migrations from Wuhan are Henan Province (5.68%), Hunan Province (3.48%) and Anhui Province (2.27%).

[38] Human mobility could be reduced during the COVID-19 outbreak for several reasons (Fang, Wang and Yang, 2020). The rapid increase of confirmed cases could create panic and lead to a decrease of human movement, as people tend to reduce the social contact to avoid the exposure to the virus. The identifications of the confirmed cases and close contacts and following self or mandatory quarantine would also have direct impacts on the human mobility. Lastly, the prevention and control policies implemented by local government could also restrict human mobility. The direct impact from the confirmed cases/close contacts may be more prevalent in the market-oriented provinces in the early period because of the large number of confirmed cases.

[39] The State Council extended seven-day Spring Festival holiday to Feb 2, 2020. It was reported that many provinces would not resume work before Feb 10, 2020. See the official source: http://www.xinhuanet.com/english/2020-

for economic recovery, led to an increase in population migration intensities, particularly in the market-oriented provinces.[40]

Table 3 reports the natural logarithm of the number of close contacts per confirmed case and the logarithm of the population migration index in both state-oriented and market-oriented provinces. Consistent with the findings in Table 2, the average daily close contact-to-confirmed case multiples are larger in state-oriented provinces than in market-oriented provinces. The difference is highly significant in the multiple calculated for cumulative close contacts and cumulative confirmed cases. On the other hand, the population migration intensities in state-oriented provinces are significantly lower than those measured by the daily migration index in 2020 during the sample period, or the migration index in 2020 scaled by the index in 2019.

[Insert Table 3 here]

4.2 Regression results

We conducted regression analysis to explore the impact of institutional development, captured by the level of marketization of each province, in response to COVID-19 and its consequence. The first argument is that local governments in state-oriented provinces tended to be constrained social planners during the COVID-19 pandemic period. They tended to quarantine more individuals than governments in market-oriented provinces. The following equation is employed to test Hypothesis H1.

$$LNMUL_{i,t} = \beta_0 + \beta_1 STATE/LNMKT_i + \beta_2 FROMWUHAN_i + \beta_3 LNCASE_{i,t} + X_i + Y_{i,t} + Date_i + \varepsilon_{i,t} \quad (1)$$

The dependent variable is the natural logarithm of the close contact-to-confirmed case multiple, calculated using either the cumulative numbers or the net increase in a province in a day. The spread of COVID-19 in provinces other than Hubei is driven by the imported cases from

02/03/c_138753176.htm, and the news https://www.cnbc.com/2020/02/01/coronavirus-more-of-china-extend-shutdown-accounting-for-80percent-of-gdp.html.

[40] The capital cities in the market-oriented provinces have higher populations and higher GDP growths; thus, they have larger within-city population migration intensities than the cities in the state-oriented provinces. We compared the ratio of migration index in 2020 to the index in 2019, which controls the impacts of the heterogeneity in different provinces.

Wuhan, Hubei. The exponent in the growth of confirmed cases is similar in other provinces since January 24, 2020 (Maier and Brockmann, 2020).[41] A higher multiple of the close contact-to-confirmed cases is associated with a stricter containment strategy in a province, as a result of overdone social distancing policies.

The key independent variables are *STATE* and *LNMKT*, which are respectively a dummy variable for a state-oriented province and the natural logarithm of marketization index in a province. If some provinces with a more state-oriented economy and a lower level of marketization are more likely to implement a rigid control policy, it is expected that the coefficient of *STATE* is significantly positive and the coefficient of *LNMKT* is significantly negative.

We included the percentage of out-flow migration from Wuhan, Hubei before January 24, 2020 (*FROMWUHAN*) and the log of the number of daily confirmed cases (*LNCASE*) in the regression as control variables. The migration flow from Wuhan could increase the risk of virus spread. Provinces that had more migration from Wuhan and confirmed cases could take stricter action and identify more close contacts. We also included three province level variables, log of GDP in 2019 (*LNGDP19*), GDP growth in 2019 (*GDPGTH19*) and the ratio of public expenditure to GDP in 2019 (*PUBHEALTH*). Economic growth in a province is a major determinant of its marketization progress (Fan et al., 2012). Public health expenditure could be associated with the health resources and the development of the health system in a province. Three weather variables based on the daily data in the capital city of a province, the average temperature in a day (*TEMPERATURE*), an indicator of a rainy day (*RAIN*) and an indicator of a snowy day (*SNOW*) are also included in the regression. These variables may be related to the spread of the virus and the difficulties of tracking close contacts. We also included the date fixed effect in the model, which can control the influence of aggregate time-series trend in the virus control and prevention.

[Insert Table 4 here]

Table 4 reports the results from OLS regressions using Equation (1). Columns (1) and (2) of Table 4 show that the coefficients of *STATE* are positive and highly significant. The results indicate that after controlling for the spread of COVID-19, heterogeneity in the provinces and weather conditions, state-oriented provinces had 59.3% and 48.6% higher close contact-to-

[41] The medical studies indicate that average basic reproduction number of COVID-19 in China was around 3.28 in 2020 (Liu et al., 2020).

confirmed case multiples and new close-contact-to-new confirmed case multiples, respectively, in a day than market-oriented provinces. Columns (3) and (4) indicate that a 10% increase in marketization index in a province leads to approximately 10.67% and 9.94% decreases in the close contact-to-confirmed case multiple and new close-contract-to-new confirmed case multiple in a day, respectively.[42] We show that marketization level can significantly reduce the number of close contacts per confirmed case in a province. In sum, the results confirm Hypothesis H1 that in response to COVID-19 spreading, local governments in the state-oriented provinces constrained individuals to a greater extent than those in the market-oriented provinces.

Column (1) of Table 4 shows that the close contact-to-confirmed case multiple significantly increased with the percentage of migration from Wuhan, although the coefficients of the variable *FROMWUAHN* are not significant in other regression models. The number of close contacts per confirmed case significantly increases with the number of confirmed cases for all models, indicating that provincial governments adopted more stringent control measures when the risk of virus spread is high. The coefficients of the three province level variables are all negative and significant. The results indicate that provinces with strong economic performance and more health resources tended to quarantine fewer close contacts per confirmed case. The close contact-to-confirmed case multiple is not affected by daily temperature but significantly reduced on a snowy day.

We further explored the impacts of institutional development on human mobility during the pandemic period across 28 provinces. We controlled for the potential risk of the virus spread from Wuhan due to migration and the effects of the number of confirmed cases and the extent of quarantine of close contacts.

$$LNIMG_{i,t} = \beta_0 + \beta_1 STATE/LNMKT_i + \beta_2 LNNMUL_{i,t} + \beta_3 FROMWUHAN_i + \beta_4 LNCASE_{i,t} + X_i + Y_{i,t} + Date_t + \varepsilon_{i,t} \quad (2)$$

[42] A 10% increase of marketization index is equivalent to an average 0.7 increase of the index score in the sample (10% x 7.018). The increase of 0.7 marketization index score is approximately corresponding to the difference of marketization index between Xinjiang (4.1) and Inner Mongolia (4.8), Heilongjiang (6.14) and Liaoning (6.75), and Fujian (9.15) and Guangdong (9.86).

The dependent variable is the natural logarithm of the within-city migration index in a capital city of a province in a day or the natural logarithm of the within-city migration index scaled by the index in the previous year (Fang et al., 2020). The key independent variables are also *STATE* and *LNMKT*. The variable *LNNMUL* is the log of the new close contact-to-new confirmed case in a province in a day. *FROMWUHAN* and *LNCASE* are the migration from Wuhan and the log of the number of daily confirmed cases. We also included the province level variables, daily weather variables and date fixed effect in the regressions.

[Insert Table 5 here]

Table 5 reports coefficient estimates from OLS regressions using Equation (2). The results in Columns (1) and (2) of Table 5 show that state-oriented provinces have significantly lower migration intensities than market-oriented provinces, a smaller 16.8% for within-city migration index, and a smaller 18.1% for the adjusted migration index. The coefficients of the key dependent variables *STATE* are significant at the 1% level. The magnitudes are also significant. The coefficients on *LNMKT* are also highly significant. If a province has a 10% improvement in its marketization level, the migration during the virus spread period would increase by approximately 2.26% measured by the raw migration index and 1.69% measured by the adjusted migration index. These findings are consistent with our hypothesis that local governments in market-oriented provinces encouraged individuals to return to work and firms to resume production so as to maintain economic momentum, whereas the overdone social distancing measures in state-oriented provinces had curtailed human mobility.

Migration intensity decreases if the ratio of close contacts to confirmed cases is high in a province in a day. This reflects a depressing effect on human migration caused by the quarantine measures on close contacts. The coefficients of *FROMWUHAN* are negative and significant in Columns (1) and (2) of Table 5. The migration index is significantly lower if the number of confirmed cases is large in a day, indicating people tend to reduce social activities to avoid exposure to the virus (Fang, et al., 2020). Migration intensity is positively associated with GDP, GDP growth, and public health resources in a province. It is natural that population migration is more intense in a more economically advanced province. Migration intensity increases with temperature but decreases on snowy days.

Taken together, although state-oriented provinces had fewer confirmed cases and a lower chance of the COVID-19 spread than market-oriented provinces, local governments in those provinces took much more stringent infection prevention and control action, as shown in the larger close contact-to-confirmed case multiple and lower migration intensity. The institutional development of a province, whether it is a state-oriented province, such that local government is a constrained social planner, or it is a market-oriented province where local government take into account the economic cost of social distancing policies, could explain the differences in government responses to the sudden public health emergency, particularly where no uniform protocol has been announced by central government and the rules kept changing. This is consistent with how provincial governments handle local economic growth and urban development in the transition from a state-led economy to a market-led economy (Wu, 2002; 2017; Yeh et al., 2015).

4.3 Further tests

The findings above document the importance of institutional development in determining a local government's response to COVID-19. The tests focus on the pandemic period from January 23, 2020 to February 26, 2020. In this section, the analysis is expanded to the period of the first quarter of 2020 and the post-pandemic period from 2020Q2 to 2022Q1. In the first batch of analyses, a sample of 286 prefecture and above cities in China is employed to examine the economic costs of government response across cities with different institutional levels of development. The second set of analyses explores whether cities adopted different strategies to contain the spread of virus in the local outbreaks after 2020Q1.

Previous studies (e.g., Fang et al., 2021; Shen et al., 2021) show that COVID-19 and the duration of social distancing policy, i.e., implementing Level 1 ERS, have significantly negative economic consequences. According to the hypotheses above, state-oriented governments adopted overdone social distancing policies, and thus the economic cost of implementing the Level 1 ERS should be greater in the state-oriented cities than the market-oriented cities. The following model is employed to test the argument:

$$GDPGRH_i = \alpha_0 + \alpha_1 ERS_i + \alpha_2 LOCKDOWN_i + \alpha_3 FROMWUHAN_i + \alpha_4 LNCASE_i + X_i + \varepsilon_i \quad (3)$$

[Insert Table 6 here]

The dependent variable is the GDP growth rate in a city in 2020Q1. The key independent variable (*ERS*) is the proportion of days in 2020Q1 for which a city implemented the Level 1 ERS. Control variables include a dummy variable for lockdown policy effect on out-flow migration from Wuhan, Hubei before January 24, 2020 (*FROMWUHAN*), the log of the number of daily confirmed cases (*LNCASE*) and other city characteristics. Table 6 reports the results. Column (1) shows that the duration of the Level 1 ERS significantly reduced economic growth in Chinese cities in the first quarter of 2020. A one-day increase in the duration of the Level 1 ERS led to a decrease of GDP growth by 0.37%. Columns (2) and (3) shows the results for state-oriented and market-oriented cities separately. The Level 1 ERS significantly harmed economic growth in both types of city. The magnitude is larger in the state-oriented cities. A one-day increase in the duration of Level 1 ERS decreases GDP growth by 1.13% in the state-oriented cities and by 0.48% in the market-oriented cities. Untabulated results also find that population flows (within-city migrations and inflow-migrations) reduced more during the period of the Level 1 ERS in the state-oriented cities than in the market-oriented cities, suggesting that state-oriented governments adopted more stringent social distancing policies than market-oriented governments. Combined together, these findings indicate that overdone social distancing policies were likely to be implemented by state-oriented governments, leading also, to substantial economic cost.

This study further analysed government responses to local outbreaks in 32 cities from 2020Q1 to 2022Q1. Most of these local outbreaks were caused by imported cases. Among them, 18 outbreaks occurred in the state-oriented cities and 14 in the market-oriented cities. Three dimensions that capture the stringency and efficiency of government response were examined, a) whether a city adopted strict control (or selective control) to contain the spread of virus, b) how long it took to contain the epidemic spread and c) how many confirmed cases there were during the outbreak (Chen et al., 2021; Yang and Chong, 2021). Strict control includes city lockdown, home confinement, travel ban and other policies for the whole city. Selective control involves some specific regions only, in a city and does not impose travel restrictions and quarantines in other regions. The time to contain the epidemic spread is the number of days from the date of the first local case to the date without any new case arising.

[Insert Table 7 here]

In Table 7, government response and efficiency levels are compared between state-oriented cities and market-oriented cities. 50% of state-oriented cities adopted a strict control policy after the local outbreak, while all market-oriented cities chose a more precise selective control policy. State-oriented cities took an average 31 days to contain the outbreak and market-oriented cities took a significantly shorter 18 days to reach the epidemic plateau. The number of confirmed cases during the outbreak is also much higher in the state-oriented cities than in the market-oriented cities. Taken together, state-oriented cities were more likely to adopt stringent but low-efficiency policies in containing the spread of virus than market-oriented cities. In sum, the findings again suggest that institutional development level is an important factor affecting the stringency and economic efficiency of local government responses to urban pandemics.

5. Discussion and Conclusions

Social norms and culture affect people's risk perceptions in relation tof COVID-19 and government strategies to fight the virus (Van Bavel et al., 2020). Governments in tighter culture societies tend to adopt stringent social distancing policies to prevent transmission of the coronavirus. Strong government control in China since late January 2020 had effectively controlled the spread of COVID-19 (Shaw et al., 2020). However, social distancing policies, as well as other voluntary and mandatory restrictions, significantly reduced human mobility (Gupta et al., 2020; Qiu et al., 2020), leading to workforce reduction, job losses, and a plunge in economic output (Nicola et al., 2020; Fernandes, 2020). Too aggressive, or 'overdone' social distancing policies bear significant economic costs and reduce levels of social welfare (Fenichel, 2013). This study exploits the variations in government responses to COVID-19 by cities in China and investigates whether institutional development level affects the stringency of social distancing policies adopted by local governments.

This study shows that provinces in China adopted different control policies in response to COVID-19 during the early national outbreak of 2020Q1, such as the period of application of the Emergency Response Situation, extent of information disclosure, the use of contact tracing techniques and the identification of personnel in close contact with confirmed cases. Empirically, we found that local governments in the state-oriented provinces quarantined 59.3% more close contact personnel for each confirmed case than did governments in market-oriented provinces,

even though the transmission risk of COVID-19 was higher in the market-oriented provinces due to the closer connection between epicentres. Hence, the results confirm that the local governments in state-oriented provinces tend to be constrained social planners who constrained individuals regardless of health classification. The state-oriented provinces had a 16.8% lower population migration intensity than the market-oriented provinces, probably due to their overdone social distancing policies. The findings also indicate that overdone policies may be associated with significant economic costs, e.g., a larger reduction in economic growth, if economic activities are restricted. Finally, in the second "ongoing" stage of pandemic control from 2020Q2 to 2022 Q1, we found out 14 market-oriented cities took significantly shorter time (18 days) to contain the local outbreaks than average 31 days of 18 state-oriented cities. Also, the number of confirmed cases during the outbreak is also much higher in the state-oriented cities than in the market-oriented cities.

Our findings have important implications for the control policies that governments adopt to diminish COVID-19. First, we show that overdone social distancing policies can significantly reduce social welfare, even though some initial strict policies, such as lockdown, can shorten the duration of the policies and accelerate a quick return to pre-pandemic activity (Guan et al., 2020). Building a system to promote effective prevention and control of the spread of the virus includes identifying confirmed cases and tracing possible cases in a short time, and promoting a social distance policy among all city residents in general. A careful evaluation of the policies is needed, with emphasis on taking account of the economic consequences of the control strategies involved, constraining targeted individuals based on their health status and avoiding overdone social distancing policies.

Second, technology could play an important role in constraining the virus transmission and maintaining economic activities. The Health QR code was widely used in China to trace targeted individuals based on their health status and potential risk of exposure to COVID-19. The COVID prevention system in China works very well that only two deaths have been reported from 15 May 2020 to February 2022 (Chen and Chen, 2022). How the whole prevention system works could be summarized into two parts: the first part is the quick diagnosis and treatment of positive cases, and the second part is the precise targeting and control of potentially infected population, both supported by mobile internet tracing techniques. No-direct-contact strategies based on mobile internet technologies has been widely used in the logistics and retail industries, such as driverless

delivery robots in hotels, apartments and university campuses, residential community, and even the take-away coffee shop.

Finally, while local institution type is an important factor determining government response to a public health crisis (see also in Cheng et al., 2020), governments taking economic consequences into account would balance the benefits and costs of different social distancing policies. They would respond rapidly to the virus pandemic and relax the strictness of response policies so as to decrease the economic loss. As shown above, the more marketized provinces such as Guangdong were quick to launch a Level I Emergency Response Situation in facing the potential pandemic of COVID-19 in January 2020, and were also the first to issue a downgrade of the Level II Emergency Response Situation when the virus was generally constrained. Those cities in the provinces which took account of the health of their economies with early ERS level downgrades, recovered from the crisis more quickly.

After the pandemic had been effectively controlled overall the country in 2020Q1, 35 sporadic breakouts happened at city or county scale in following 20 months. When multiple positive cases appeared, market-oriented cities tended to use “local” strategy, including 3-layers lockdown zones, to more precisely to single community or block to decease the impact on economic activities and daily life of city residents. Table 8 shows that the targeting and control system is composed by three-scale strategy namely national, provinces and cities, and the last one is mainly activated by city government on “local” standard. In the third quarter of 2021, 5 local outbreaks happened in Ruili, Nanjing, Zhengzhou, Xiamen, and Harbin. City governments in Zhengzhou and Xiamen firstly introduced the 3-layers lockdown zones policy and contained the pandemic in 24 and 27 days separately, while the less marketized city like Ruili had taken 62 days to recover urban vitality. On the other side, the purpose of provincial strategy is mainly to help other provinces to screen travelers from high-risk and medium-risk areas. More marketized city tended to use looser standard to identify risk to reduce the impact on external economic activities. Even more than 107 thousand positive cases had been reported in Shanghai (a market-oriented city) till April 5, 2022, there was no single high-risk area and only 13 medium-risk areas has been publicized.

[Insert Table 8 here]

Overall, our results imply that some local governments had implemented rather too strict social distancing policies without sufficient consideration of the economic consequences, which

could both reduce the social welfare of residents and damage economic growth. In future work, we will analyze the effects of government disease control policies on mortality, economic output and unemployment, and evaluate the consequences of overdone and inadequate virus control policies. The studies will have policy implications for governments still struggling to diminish COVID-19 right now or preparing for the next global pandemic.

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Appendix 1: Variable definitions

Variable	Definition
CONFIRM	The number of cumulative confirmed cases in a province in a day
CONTACT	The number of cumulative close contacts of probable and confirmed patients in a province in a day
ERS1DAY	The proportion of days that local government implemented a Level I Emergency Response Situation in 2020Q1
FROMWUHAN	The percentage of outflow population from Wuhan to a province between Jan 10, 2020 and Jan 24, 2020
GDP19	GDP in a province (or a city) in 2019
GDPGTH	GDP growth rate in a city in the first quarter of 2020
GDPGTH19	GDP growth rate in a province (or a city) in 2019
IMGRATION	Within-city migration index in the capital city of a province in a day
IMGRATION19	Within-city migration index in the capital city of a province in a corresponding date in 2019
LNCASE	The log of the number of confirmed case in a city in 2020Q1
LNGDP19	Natural log of GDP in a province (or a city) in 2019
LNIMG	Natural log of within-city migration index in the capital city of a province in a day
LNIMGADJ	Natural log of adjusted within-city migration index in the capital city of a province in a day; the adjusted index is the migration index in 2020 divided by the index in a corresponding date in 2019
LNMKT	Natural log of marketization index in a province
LNMUL	Natural log of the number of close contacts per confirmed case in a province in a day
LNNMUL	Natural log of the number of new close contacts per new confirmed case in a province in a day
MARKETIZATION	Marketization index in a province given by Fan, Wang and Zhu (2019)
MULTIPLE	The number of close contacts per confirmed case in a province in a day
NEWCASE	The number of new confirmed cases in a province in a day
NEWCONTACT	The number of new close contacts of probable and confirmed patients in a province in a day
NEWMULTIPLE	The number of new close contacts per new confirmed case in a province in a day
PUBHEALH	The ratio of public healthcare expenditure to GDP in 2019 in a province (or a city)
RAIN	Dummy variable indicating whether it rains in a day in the capital city of a province
SNOW	Dummy variable indicating whether it snows in a day in the capital city of a province
STATE	Dummy variable indicating whether a province is state-oriented; equal to one if a province's marketization index is larger than the median value of the marketization index in the sample
TEMPERATURE	The average temperature in a day in the capital city of a province

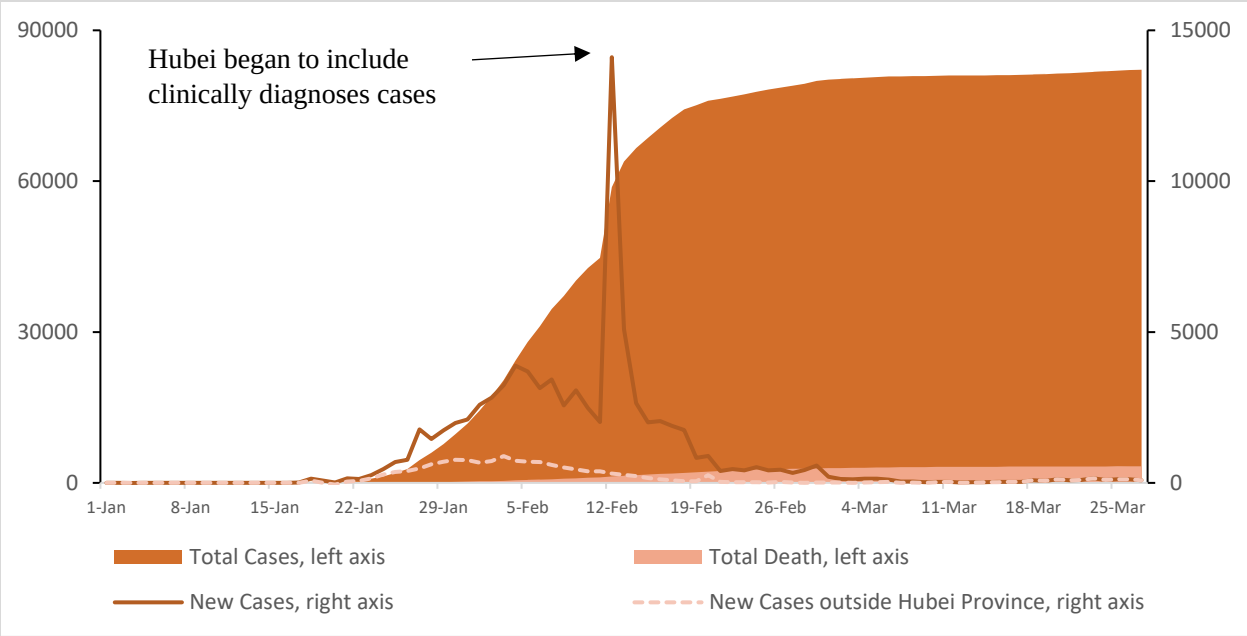

Figure 1: Number of total confirmed case and daily new cases in Mainland China (till March 25, 2020)

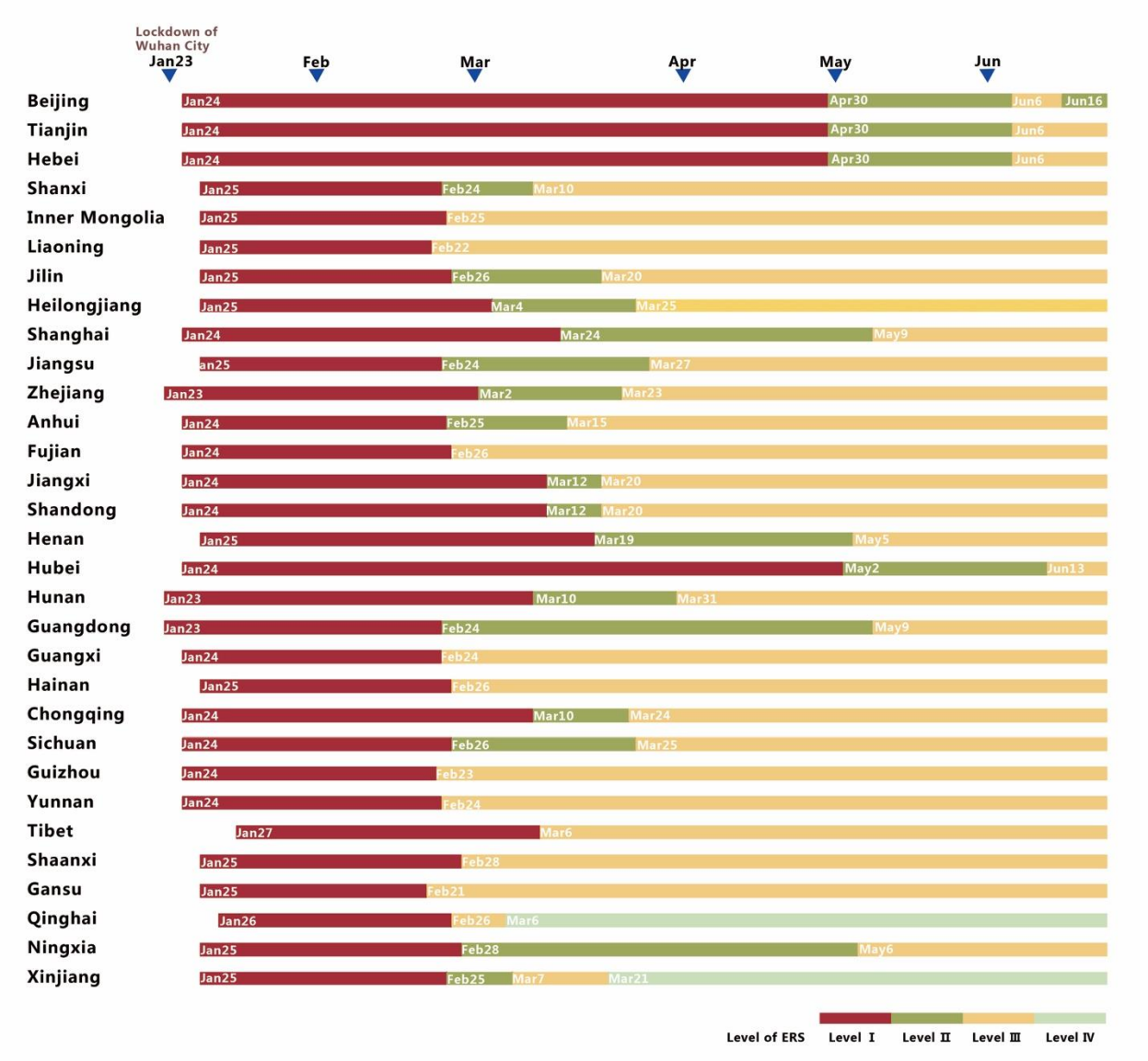

Figure 2: Upgrade and downgrade time of Emergency Response Situation in different provinces in China (till June 30, 2020)

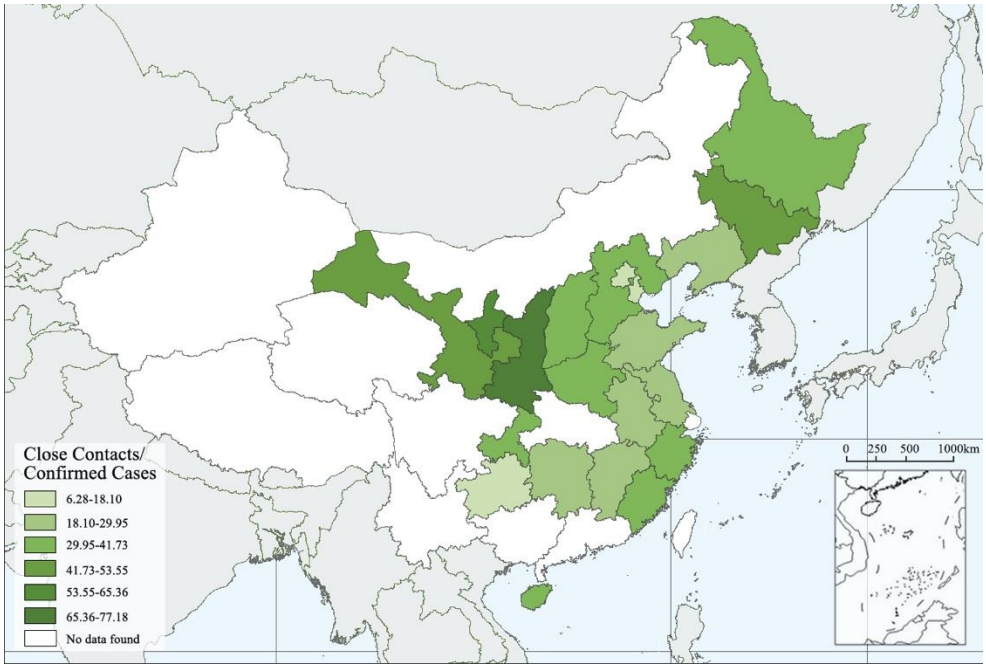

Figure 3: Provincial close contacts to confirmed cases of COVID-19 in Mainland China (till Feb. 26, 2020)

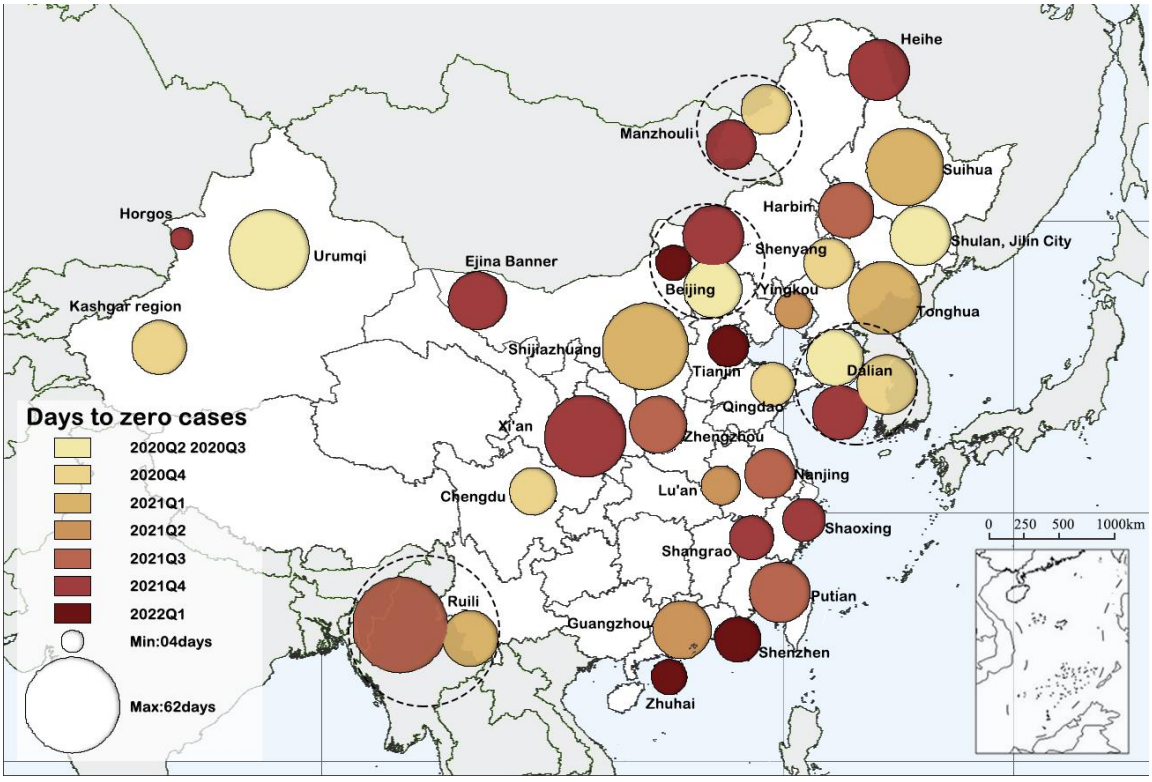

Figure 4: Local outbreaks in Mainland China from 2020Q2 to 2022Q1, Days the positive cases turn to zero.

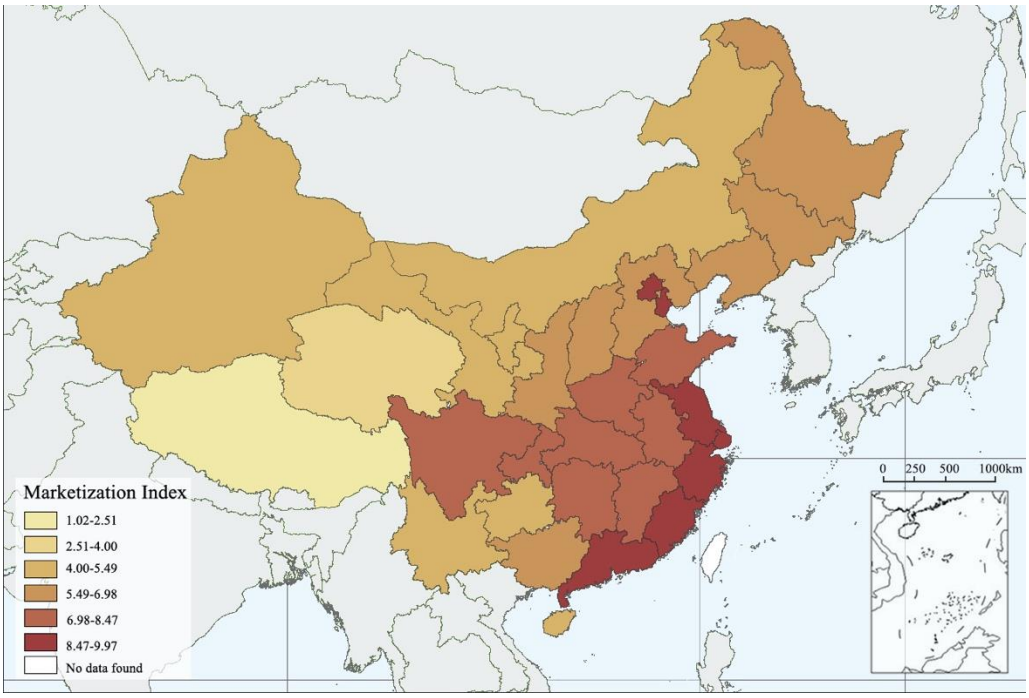

Figure 5: Marketization index of provinces in Mainland China in 2016

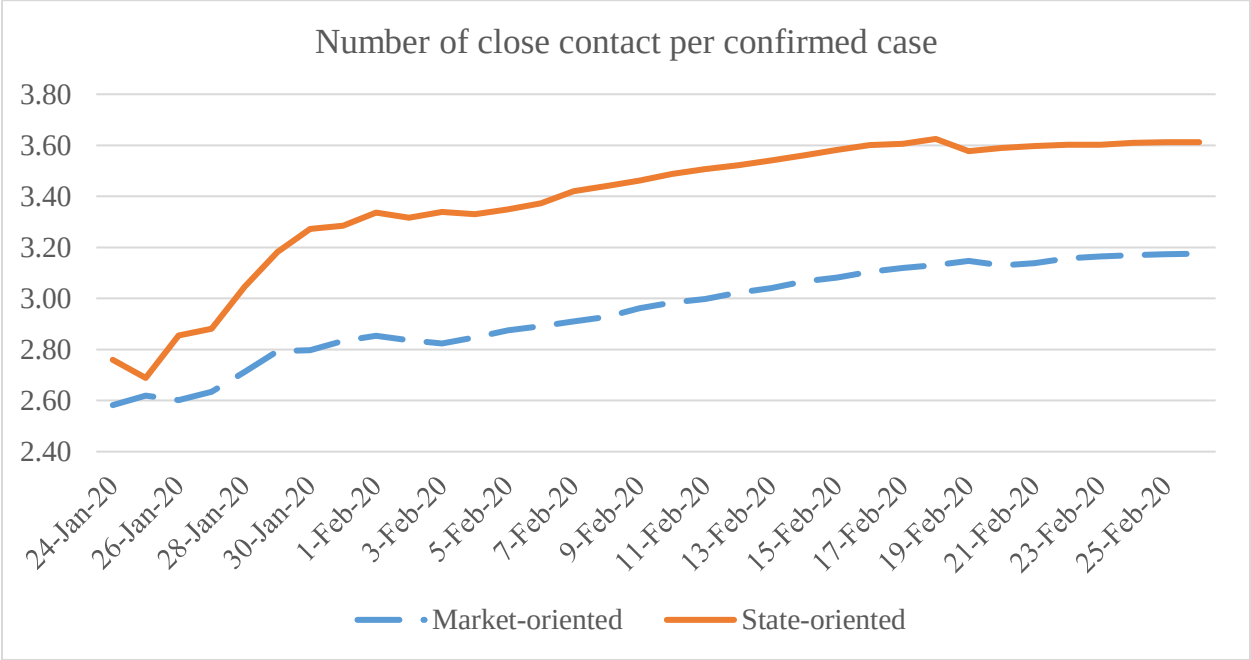

Figure 6: The number of close contacts per confirmed case between market-oriented and state-oriented provinces

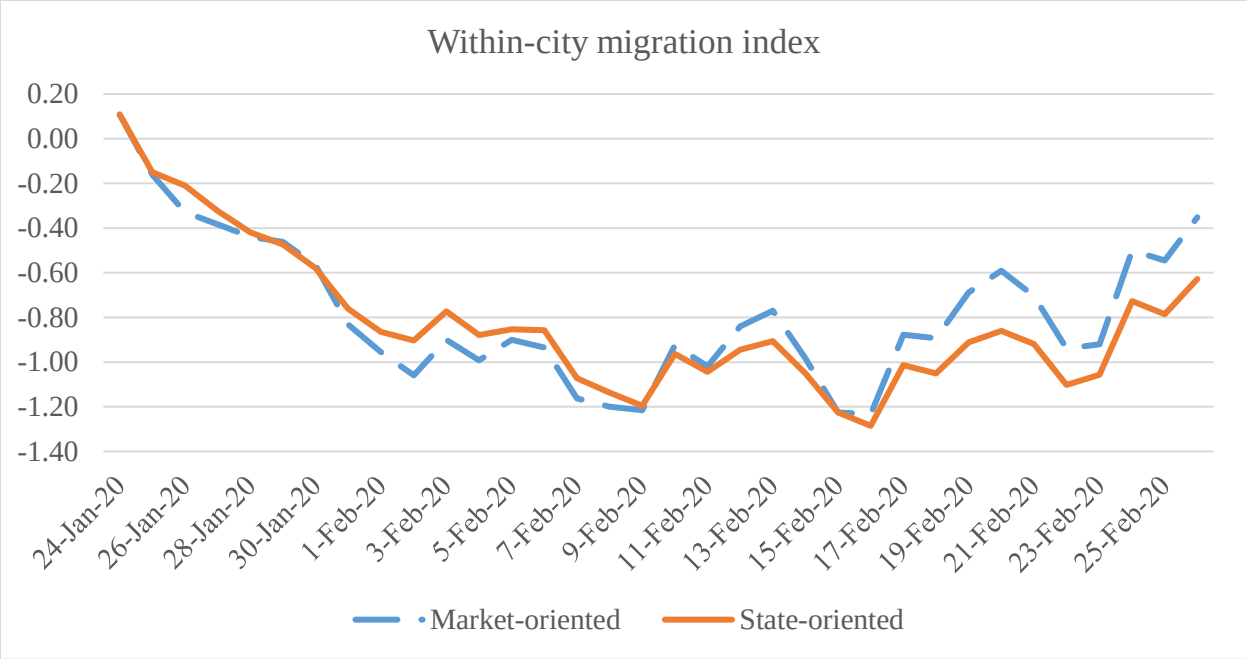

Figure 7: Within-city immigration index between market-oriented and state-oriented provinces

Table 1

Summary statistics

Panel A: daily variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
CONFIRM	952	316.72	344.66	2	1347
NEWCASE	952	13.21	20.38	0	202
CONTACT	764	8564.43	9583.00	10	40939
NEWCONTACT	756	424.18	528.32	0	3831
MULTIPLE	764	27.14	13.49	3.33	77.18
NEWMULTIPLE	756	52.18	83.48	0	1046
LNMUL	764	3.16	0.59	1.20	4.35
LNNMUL	735	3.35	1.18	-1.39	6.95
IMGINDEX	952	1.92	0.64	0.30	4.35
IMGINDEX19	952	4.13	0.92	1.47	6.15
LNIMG	952	0.59	0.38	-1.20	1.47
LNIMGADJ	952	-0.80	0.42	-2.64	0.19
TEMPERATURE	952	5.05	8.73	-23	25
RAIN	952	0.13	0.33	0	1
SNOW	952	0.03	0.16	0	1

Panel B: province level variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
STATE	28	0.500	0.51	0	1
MKTINDEX	28	7.018	1.82	4.1	9.97
FROMWUHAN	28	1.08%	0.01	0.0008	0.0568
GDP	28	3,338.719	2596.02	374.85	10767.11
LNGDP19	28	7.832	0.80	5.93	9.28
GDPGTH19	28	8.17%	0.03	0.04	0.17
PUBHEALH	28	6.13%	0.02	0.03	0.10

Note: this table presents the summary statistics. Panel A gives the statistics of the daily variables. Panel B presents the statistics of the province level variables. The detailed variable definitions are in the Appendix 1.

Table 2

The confirmed cases, close contacts, migration from Wuhan and GDP growth in each provinceProvince

	Confirmed	Close contact	Multiple	From Wuhan	Province	Confirmed	Close contact	Multiple	From Wuhan
Market-oriented:					State-oriented:				
Anhui	989	27,823	28.13	2.27%	Gansu	91	4,261	46.82	0.35%
Beijing	410	2,574	6.28	0.86%	Guangxi	252	--	--	0.79%
Chongqing	576	23,441	40.70	1.27%	Guizhou	146	2,574	17.63	0.55%
Fujian	296	10,881	36.76	0.91%	Hainan	168	6,139	36.54	0.38%
Guangdong	1,347	--	--	1.94%	Hebei	317	10,675	33.68	0.93%
Henan	1,272	39,134	30.77	5.68%	Heilongjiang	480	16,188	33.73	0.28%
Hunan	1,017	26,846	26.40	3.48%	Inner Mongolia	75	--	--	0.18%
Jiangsu	631	12,625	20.01	1.46%	Jilin	93	3,992	42.92	0.17%
Jiangxi	934	26,284	28.14	2.12%	Liaoning	121	2,717	22.45	0.33%
Shandong	756	16,802	22.22	1.10%	Ningxia	72	4,447	61.76	0.08%
Shanghai	337	--	--	0.66%	Shaanxi	245	18,910	77.18	0.72%
Sichuan	534	--	--	1.24%	Shanxi	133	4,140	31.13	0.59%
Tianjin	135	2,209	16.36	0.15%	Xinjiang	76	--	--	0.20%
Zhejiang	1,217	40,939	33.64	1.07%	Yunnan	174	--	--	0.53%
Overall:	747	20,869	26.31	1.73%	Overall:	175	7,404	40.39	0.43%

This table reports the confirmed cases, the close contacts and the multiples (the confirmed / the close contact) as of Feb 26, 2020 in each province. It also presents the percentage of the out-migration populations from Wuhan to each province between Jan 10, 2020 to Jan 24, 2020 and the GDP growth of each province in 2019. The 28 provinces are divided into two categories, market-oriented and state-oriented, based on the marketization index in 2016.

Table 3

New contact per confirmed case and migration index in different provinces

	State-oriented	Market-oriented	Diff.	t-stat
LNMUL	3.364	2.937	0.427	(10.56)***
LNNMUL	3.420	3.279	0.141	(1.62)
LNIMG	0.934	0.977	-0.043	(-1.83)*
LNIMGADJ	-0.631	-0.565	-0.066	(-2.77)***

This table reports the differences of the daily close contact multiple and the daily with-city migration index between the government-led and market-led provinces. The *t-statistics* are reported in parentheses. ***, **, * represent the statistical significance at 1%, 5% and 10% level, respectively.

Table 4

Local governance, marketization, and new contact per confirmed case

	(1)	(2)	(3)	(4)
	LNMUL	LNNMUL	LNMUL	LNNMUL
STATE	0.593	0.486		
	(8.03)***	(3.25)***		
LNMKT			-1.067	-0.994
			(-6.62)***	(-3.00)***
FROMWUHAN	6.414	5.868	-2.039	-1.726
	(5.02)***	(1.55)	(-1.34)	(-0.41)
LNCASE	0.192	0.510	0.161	0.490
	(5.01)***	(5.30)***	(4.32)***	(5.20)***
LNGDP19	-0.222	-0.547	-0.127	-0.456
	(-4.89)***	(-4.72)***	(-2.78)***	(-3.86)***
GDPGTH19	-6.944	-6.308	-7.979	-7.011
	(-7.01)***	(-3.69)***	(-8.26)***	(-4.23)***
PUBHEALH	-9.238	-17.095	-7.487	-16.223
	(-4.10)***	(-3.08)***	(-3.46)***	(-2.92)***
TEMPERATURE	0.002	-0.010	0.001	-0.011
	(0.65)	(-1.41)	(0.32)	(-1.53)
RAIN	0.117	0.130	0.087	0.104
	(2.13)**	(1.10)	(1.52)	(0.87)
SNOW	-0.399	-0.578	-0.374	-0.558
	(-3.90)***	(-2.27)**	(-3.65)***	(-2.23)**
Constant	4.666	6.295	6.518	7.951
	(10.79)***	(6.35)***	(15.43)***	(7.42)***
Date Fixed Effect	Yes	Yes	Yes	Yes
N	782	735	782	735
R-squared	0.429	0.214	0.417	0.215

This table presents the results of Eq. (1) that estimates the impacts of governance-orientation and marketization on new contact multiple in the period between Jan 24, 2020 to Feb 26, 2020. The dependent variables are the natural logarithm of the number of close contacts to the number of confirmed case and the natural logarithm of the number of new close contact to the number of new confirmed case in a day in a province. The key independent variable *STATE* is a dummy variable equal to one if the marketization index in province is below the median of the 28 provinces and zero otherwise. *LNMKT* is the natural logarithm of the marketization index in a province. The control variables include: the percentage of the out-migration populations from Wuhan, the log of the number of confirmed case, the log of GDP in 2019, GDP growth in 2019, the ratio of public health expenditure to GDP, the daily temperature, and the dummy variables of rain day and snow day. The detailed variable definitions are in Appendix 1. Date fixed effect is included in the regressions. The *t*-statistics adjusted by robust standard error are reported in parentheses. ***, **, * represent the statistical significance at 1%, 5% and 10% level, respectively.

Table 5

Local governance, marketization, and migration index

	(1)	(2)	(3)	(4)
	LNIMG	LNIMGADJ	LNIMG	LNIMGADJ
STATE	-0.168	-0.181		
	(-6.15)***	(-6.63)***		
LNMKT			0.226	0.169
			(4.75)***	(3.80)***
LNNMUL	-0.008	-0.019	-0.010	-0.022
	(-1.01)	(-2.67)***	(-1.20)	(-2.99)***
FROMWUHAN	-1.664	-1.503	0.223	0.063
	(-2.12)**	(-1.79)*	(0.25)	(0.07)
LNCASE	-0.190	-0.207	-0.173	-0.183
	(-9.87)***	(-12.44)***	(-9.32)***	(-11.29)***
LNGDP19	0.128	0.165	0.105	0.146
	(5.93)***	(9.39)***	(4.96)***	(8.07)***
GDPGTH19	1.022	1.263	1.351	1.672
	(2.80)***	(3.72)***	(3.69)***	(5.00)***
PUBHEALH	3.896	5.992	2.765	4.240
	(3.46)***	(6.04)***	(2.61)***	(4.76)***
TEMPERATURE	0.002	0.010	0.002	0.009
	(1.64)	(7.79)***	(1.49)	(7.61)***
RAIN	0.013	0.017	0.019	0.022
	(0.50)	(0.81)	(0.73)	(1.00)
SNOW	-0.079	-0.076	-0.082	-0.078
	(-1.87)*	(-1.76)*	(-1.99)**	(-1.80)*
Constant	0.386	-1.349	-0.013	-1.669
	(2.08)**	(-8.13)***	(-0.06)	(-9.40)***
Date Fixed Effect	Yes	Yes	Yes	Yes
N	735	735	735	735
R-squared	0.494	0.713	0.480	0.699

This table presents the results of Eq. (2) that estimates the impacts of governance-orientation and marketization on human mobility in the period between Jan 24, 2020 to Feb 26, 2020. The dependent variables are the natural logarithm of within-city migration index and the natural logarithm of within-city migration index in 2020 scaled by the index in 2019. The key independent variable *STATE* is a dummy variable equal to one if the marketization index in province is below the median of the 28 provinces and zero otherwise. *LNMKT* is the natural logarithm of the marketization index in a province. The control variables include: the percentage of the out-migration populations from Wuhan, the log of new close contact to the new confirmed case, the log of the number of confirmed case, the log of GDP in 2019, the GDP growth in 2019, the ratio of public health expenditure to GDP, the daily temperature, and the dummy variables of rain day and snow day. The detailed variable definitions are in Appendix 1. Date fixed effect is included in the regressions. The *t-statistics* adjusted by robust standard error are reported in parentheses. ***, **, * represent the statistical significance at 1%, 5% and 10% level, respectively.

Table 6

Local governance, emergency response, and economic growth in 2020Q1

	(1)	(2)	(3)
	GDPGRH (2020Q1)		
	Full sample	State-oriented	Market-oriented
ERS1DAY	-0.3403	-1.0246	-0.4326
	(-3.41)***	(-2.42)**	(-2.45)**
LOCKDOWN	-0.0035	0.0950	-0.0109
	(-0.12)	(1.41)	(-0.45)
FROMWUHAN	0.0025	0.7195	0.0177
	(0.34)	(2.40)**	(1.78)*
LNCASE	-0.0021	0.0096	0.0161
	(-0.14)	(0.27)	(1.47)
LNGDP19	0.0049	-0.0365	0.0040
	(0.31)	(-1.23)	(0.26)
GDPGROWTH19	0.9938	1.0888	0.8222
	(10.53)***	(6.13)***	(8.54)***
PUBHEALH	2.7539	6.2179	0.8128
	(3.32)***	(2.62)**	(0.83)
Constant	-0.1496	-0.3763	-0.0846
	(-1.69)*	(-1.43)	(-0.86)
N of cities	216	75	141
R-squared	0.433	0.515	0.501

This table presents the estimates of the impacts of local government's emergency response to COVID-19 on economic growth of 216 Chinese cities in the 2020Q1. The dependent variable is the GDP growth in the first quarter of 2020. The key independent variable *ERS1DAY* is the proportion of days that local government implemented a Level I Emergency Response Situation in 2020Q1. The control variables include: whether a city was locked down, the percentage of the out-migration populations from Wuhan, the log of the number of confirmed case, the log of GDP in 2019, the GDP growth in 2019, and the ratio of public health expenditure to GDP. The detailed variable definitions are in Appendix 1. The *t-statistics* adjusted by robust standard error are reported in parentheses. ***, **, * represent the statistical significance at 1%, 5% and 10% level, respectively.

Table 7

Local governance and government response to local outbreaks after 2020Q1

	State-oriented N = 18	Market-oriented N = 14	Diff.	t-stat
Strict control (Yes/No)	0.500	0.000	0.500	(3.62)***
Days to zero	31.167	18.357	12.810	(3.41)***
N. of cases	395.556	169.286	226.270	(1.57)

This table reports the differences of government responses to local outbreaks between the government-led and market-led provinces. Three variables are given to capture government response and the efficiency: whether a city adopted strict control (= 1 for strict control and = 0 for selective control), the number of days that there was no new confirmed cases after the first case was discovered, and the number of confirmed cases in the outbreak. The *t-statistics* are reported in parentheses. ***, **, * represent the statistical significance at 1%, 5% and 10% level, respectively.

Table 8

Targeting and control policies of potentially infected population in national, provinces and cities scales.

Scales of tar geting policy	**National**	**Provinces**	**Cities**
Objectives	Cities	Counties or Towns	Communities or blocks
Strategies	Travelers who have been to cities with high-risk or medium-risk area in past 14 days would be labeled in national Health QR pass and their entrance would be managed strictly.	Inside cities with confirmed cases, high-risk and medium-risk areas would be targeted by local government. City residents who live or travel to high-risk area would be given Red or Yellow Health QR pass and go through multiple Nucleic Acid Tests to sort out positive cases.	Three categories of lockdown zones as Closed Area, Controlled Area and Precautionary Area will be classified down to single communities or blocks by city government according to the number of confirmed cases. Residents who live in different area would be quarantined in different ways.
Effective Time	April, 2020	March, 2020	September, 2021
Standard	National standard	National standard	Local standard